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JANUARY 4, 1943
VOLUME 32, No. 1

AMERICAN DYESTUFF REPORTER

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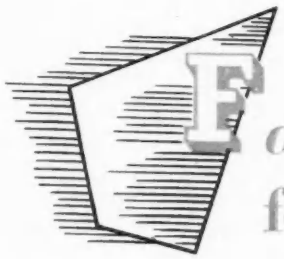
OFFICIAL PUBLICATION
of the
PROCEEDINGS
AMERICAN ASSOCIATION
OF TEXTILE CHEMISTS
AND COLORISTS



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Do you know that the color quality of dyed and printed materials for civilian use can be maintained—

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America's Highest Production Honor Won by Leading Textile Mills

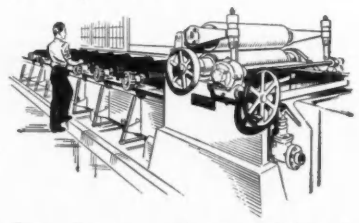
Call the roll of Army-Navy "E" Award winners in World War II . . . and you will see how magnificently the Textile Industry has responded to the demand for clothing and equipment for America's armed forces.

The tremendous yardages of fabrics needed to win the war are being turned out with remarkable efficiency. Uniforms . . . parachutes . . . tents . . . powder bags. Cottons . . . woolens . . . synthetic fibres. Duck . . . drills . . . twills.

The Textile Industry is meeting the challenge. The Army-Navy "E" is the way the procurement services have of saying "Well done."

Shown on this page are the presentation ceremonies that have taken place at a few of the mills. There have been many others. There will be many more.

Many Winners of "E" Awards Use Butterworth Machines



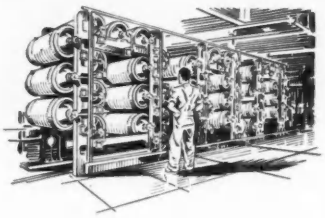
We are proud to play a part in the mighty drama of Textiles for Victory.

In many of the mills honored for production, Butterworth Machines help to speed quality and quantity of output in the Wet Finishing Department.

These mills are more than customers to us. They are old friends of the Butterworth Organization. We are glad to be partners with them once again in a great fight to crush the attackers of America.

Lanett Bleachery and Dye Works, West Point, Ga.
Seeing that Uncle Sam gets the fabrics he wants properly finished and carefully dyed according to specifications is now a full time job at Lanett Bleachery and Dye Works. It won them the Army-Navy "E." Shown at the presentation ceremonies, left to right, standing: George H. Lanier, president; Gov. Frank M. Dixon, of Alabama; Maj. Gen. Clifford L. Corbin, Assistant Quartermaster General; Lt. Col. Robert T. Stevens, Chief, Textile Clothing and Leather Sections of the Office of Quartermaster General. Front row, left to right: F. A. Wheelock, of J. B. Warne, Inc.; John A. Simmons, general manager of Lanett Bleachery and Dye Works; Joseph B. Warne.

J. L. Stifel & Sons, Inc., Wheeling, W. Va.
The presentation of the Army-Navy "E" is regarded by J. L. Stifel & Sons, Inc., as one of the most memorable events in their 107 years of existence. Stifel is supplying ever increasing quantities of their famous "Boot Brand" Fabrics to the Army, Navy and Marines. Shown holding the flag, left to right, are: Lt. Arthur C. Stifel, Jr.; Lt. Col. R. T. Stevens, Quartermaster General Office; Arthur C. Stifel, Sr.; Col. John Welch, Richmond Quartermaster Depot; Col. Harold C. Fellows; Capt. L. A. Herron; Lt. J. A. Koerber, Philadelphia Quartermaster Depot; Lt. Com. C. M. Royal.



All of the mills mentioned as "E" Award winners on this page use Butterworth Machines during wet finishing operations . . . for bleaching, boiling-out, drying, calendering, dyeing or any one of the many operations necessary to give our armed forces the clothing and equipment they need.

Butterworth Engineers are at the service of mill engineers and superintendents to keep production rolling . . . to locate and break annoying bottlenecks.

We are producing gun mounts for the United States Army. But, all of our facilities not required for Ordnance production are enlisted for the duration to help *you* solve your finishing problem.

Let our experience serve you now.

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Munsingwear, Inc., Minneapolis, Minn.

By giving priority without delay to Government business, Munsingwear, Inc., increased its volume for the armed services from 1 million dollars to 5 million dollars in a year's time. The company is now operating three shifts and is producing 16,000 to 20,000 undergarments a day. Shown holding the Army-Navy "E" pennant, left to right: Lt. Col. John N. Gage, Executive Officer, Chicago Quartermaster Depot; Ernest L. Olrich, President, Munsingwear; Brig. Gen. Joseph E. Barzynski, Commanding Officer, Chicago Quartermaster Depot; Gov. Harold E. Stassen, of Minnesota; E. C. Wilson, Vice-President, Munsingwear.

Cramerton Mills, Cramerton, N. C.

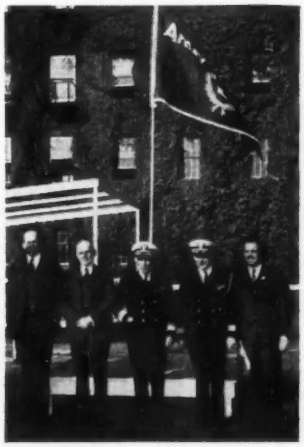
The story back of the winning of the coveted "E" by Cramerton Mills dates back to 1930, when Cramerton assisted the Quartermaster Corps in the development of the present Army Khaki, the official cotton uniform cloth. Now Navy and Marine Corps officers wear it as well. This is by no means the only military fabric made by Cramerton, but its production has been a major objective for 12 years. Shown at the presentation ceremonies are, left to right: Gov. J. M. Broughton, of North Carolina; Maj. Stuart W. Cramer, Jr.; Maj. Gen. E. B. Gregory; Capt. Alfred T. Clay, U. S. N.; Grover Cleveland Bridges, oldest employee.

Pacific Mills, Worsted Division, Lawrence, Mass.

In receiving the Army-Navy "E" Award, the Pacific Mills Worsted Division also earned the distinction of being the first worsted mill in the country to be so honored. The mill is working three shifts a day in all departments making military fabrics. Shown at the presentation, from left to right: Capt. G. C. Hall, U. S. N.; Maj. Gen. Clifford L. Corbin, Chief of Procurement Services, Office of the Quartermaster General; Gov. Leverett Saltonstall, of Massachusetts; Mayor Meehan, of Lawrence; E. D. Walen, vice-president, Pacific Mills, Worsted Division; Henry M. Bliss, president, Pacific Mills.

Aberfoyle, Inc., Norfolk, Va.

The Norfolk plant of Aberfoyle, Inc., won the Army-Navy "E" for outstanding production of nylon parachute cloth for the Army. Aberfoyle started weaving rayon goods more than 30 years ago and is one of the first mills to weave nylon into much-needed parachute fabric. The plant has been running two months ahead of schedule in fulfilling Government contracts. Edwin Lord, president of Aberfoyle, Inc., and Mrs. Mabel McDaniel, elected representative of the workers, are shown accepting the flag.



Boott Mills, Lowell, Mass.

The Boott Mills hold the honor of being the first cotton mill in New England to win the "E" award. They are also the first Lowell industry to be so honored. Boott Mills are now 100 per cent on Navy twill. Executives of the company and naval officers who officiated at the presentation are shown, left to right: J. Rogers Flather, assistant treasurer; Frederick A. Flather, Sr., treasurer and manager; Rear Admiral W. J. Carter, chief of Naval Supply Corps; Capt. Frank P. Delehanty, U. S. Navy; Frederick A. Flather, Jr.

Butterworth

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See-Worthy legs are a business with me!

GLORIA BARDEAU

The young lady in front of the fireplace knows the importance of see-worthy legs. Says GLORIA—"With professional models, attractive legs are a business . . . with all women they're a necessity, for we know there's a direct line between feminine legs and male hearts. Under today's conditions, can you blame us for being critical in our hosiery buying?"

Whether she's out to stop the fleet or just part of it, every girl knows that "see-worthy" legs are an important part of her charm equipment. Stockings in rayon, cotton or lisle . . . all must have the proper, soft, sheer, eye-caressing, smoky dullness. ■ Today, to make the job of glorifying the most beautiful legs in the world doubly difficult, materials are limited, while feminine demand and criticism is not. Never have we found hosiery makers and dyers more needful of finishes to create sheer, lasting, salable hosiery regardless of the materials used. ■ To solve these problems, our staff has been working "'round-the-clock". A talk with one of our field men will convince you that we have not worked in vain.

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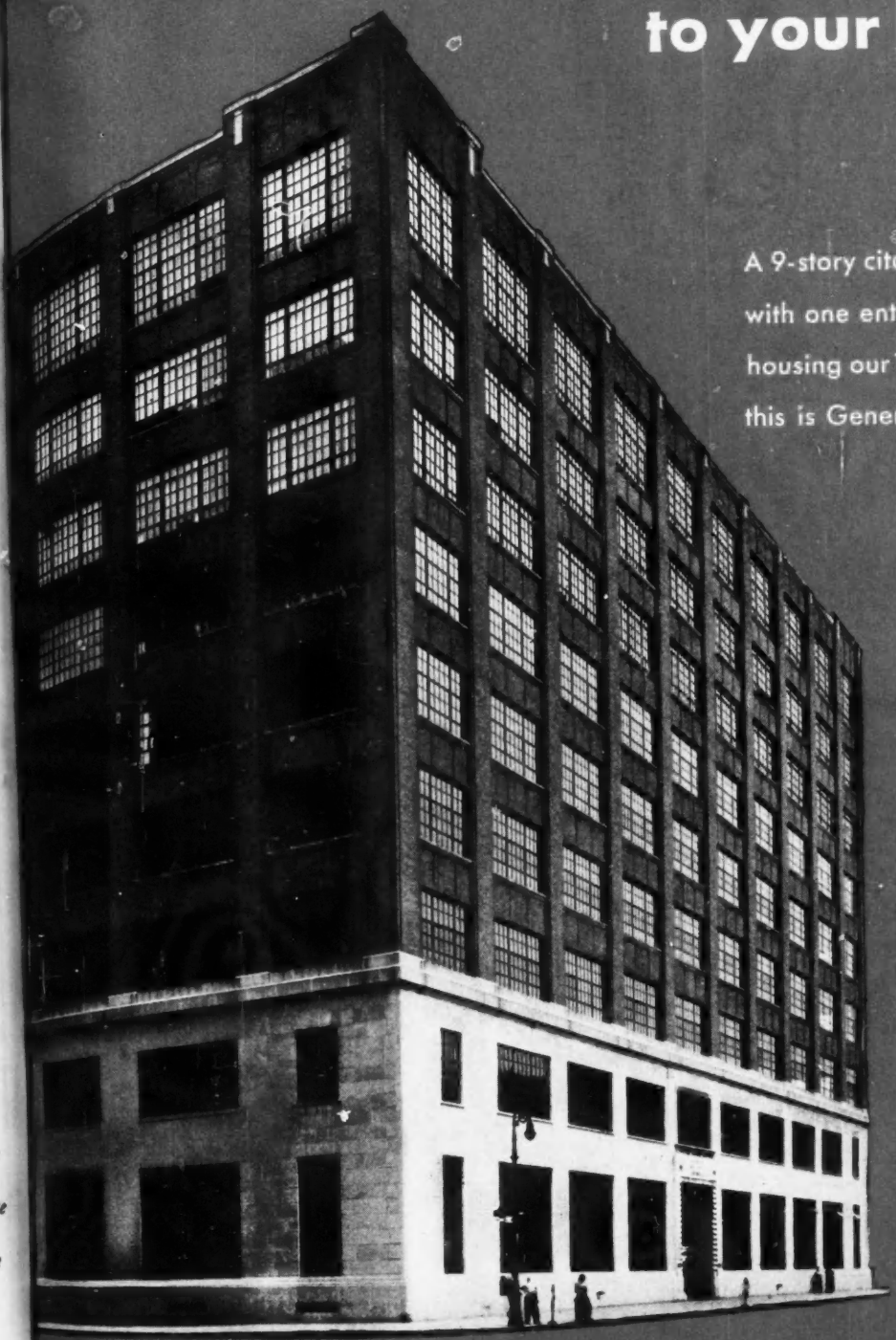

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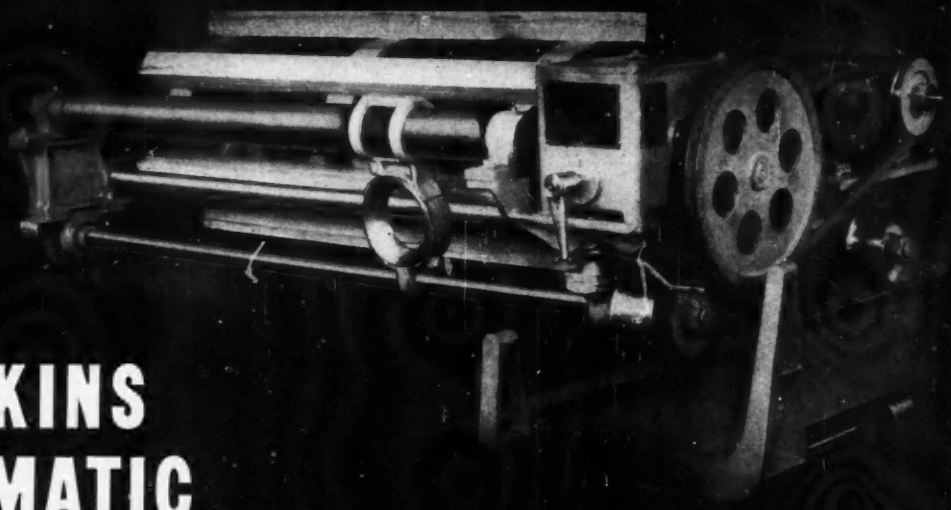

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A. P. HOWES
Publisher

LOUIS A. OLNEY, D.Sc.
Directing Editor

NORMAN A. JOHNSON, B.T.C.
Managing Editor

MYRON D. REESER
Advertising Manager

Official Publication of the Proceedings of the American Association of Textile Chemists and Colorists

JANUARY 4, 1943

VOLUME 32 NUMBER 1

American Dyestuff Reporter, Vol. 32, No. 1, Jan. 4, 1943. Published every other Monday. Copyright, 1943, by Howes Publishing Co., 440 4th Ave., New York, N. Y. Domestic subscription, $5.00, Canadian, $6.00, Foreign, $6.00. Entered as second-class matter, Nov. 6, 1919, at the New York, N. Y., Post Office, under the act of March 3, 1879.

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as light or dark; (these terms are often used by color-matchers) chroma, as strong (intense) or weak (pale). The intelligent use of this system will bring about a better agreement of color values between the dyer and the customer.

OSTWALD COLOR SYSTEM

The *Ostwald color system* is better known in the textile mills of Europe than in those of this country. The notations of this system is built up by reference to the properties of idealized pigmented surfaces having a spectral reflectance constant at a certain value between two complementary wavelengths and a constant at a certain value elsewhere. (4, 6) This system has three values; per cent hue (full color), per cent white (lightness) and per cent black (saturation). The sum of the three variables form the complete notation of the Ostwald System.

MAERZ-PAUL COLOR DICTIONARY

Other efforts toward standardizing color names resulted in compiling color dictionaries. A color dictionary defines color in terms of some material standard. There are several of these dictionaries available, the foremost of which is the Maerz-Paul Dictionary of Color, (4, 21). This book contains about 4,000 names for color, each name is keyed to one or another of the approximate, 7,000 different color samples. Each color sample is printed on semi-glossy paper. The samples are arranged according to Hue. There are eight main groups of charts. Each group covers a different Hue range. The charts of each group differs only in lightness. The color names are derived from many fields, namely, textiles, paints, ceramics, scientific and artistic.

The reader is referred to the bibliography for a complete description of these color systems.

Through the efforts of The Textile Color Card Association, the dyer has succeeded in standardizing the names of finished colors throughout the country. By adopting the color notations of the "Munsell" system a dyer may simplify the language used to specify a color. However, this is but a partial answer to the dyer's problem, since knowing how to name a color and to specify relative color differences will not aid the dyer materially in obtaining the desired shade. In all of these systems no provisions have been made for a standard observer, and the dyer soon found that here as in matching a color in production, the final decision rests on personal observation, and opinions thus advanced form the topic of endless disagreement. Hence, the art of color matching still prevails in the dyeing industry.

To convert the art of dyeing to a science, a standard means of color measurement must be found. This method must be independent of personal observation and it must be reproducible at all times, under all conditions.

In the search for an accurate method of color specification the dyer must turn to the physicist. This scientist has investigated the properties of light and color, and found that color is entirely dependent on light. Where there is no light there will be no color.

LIGHT

Any discussion of color with the physicist is a discussion of light and its properties. Let us digress for a moment and review some of the properties of light in order to understand "color" as the physicist sees it.

Light is a form of radiant energy. It forms but a small part of a whole series of electromagnetic radiations, which are classed as radiant energy. The various forms of radiant energy are: cosmic rays, x-rays, ultra-violet rays, visible light, infra-red rays, electromagnetic or Hertzian waves, radio waves, and waves carried through wires.

Light moves through vacuum at a speed of 186,000 miles, or 300,000 kilometers per second. The flow of light is not continuous, but comes in a definite number of impulses per second depending on the character of the light. Newton thought that this discontinuous flow was due to individual light particles, Huygens thought that this interrupted flow was due to a wave characteristic of light. The modern physicist makes use of both of these theories, although recent evidence seems to support Newton's view. It doesn't matter which theory you adopt, the important facts are:

1. All radiant energy travels at a constant speed, namely 186,000 miles per second. This is termed the velocity.

2. The flow of radiant energy is not smooth, but a definite number of impulses, or waves pass a given point per second. This number varies with the character of radiant energy. This property is termed the frequency.

3. The distance between impulses, or crests of waves is measurable. This measure is the wavelength.

The three terms, velocity, frequency, and wavelength will give the properties which identify the character or radiant energy. The relationship among the terms is expressed by the following formula: (7).

$$\text{Wavelength} = \frac{\text{Velocity} \quad (v)}{\text{Frequency} \quad (n)}$$

Since all of the waves possess a common velocity of 186,000 miles per second, there can only be a difference in the frequency resulting in various wavelengths. The waves of the electromagnetic series varies from miles between the crests of electric current, down to a millionth of a millimeter for the cosmic ray series. The units for measuring thousandths and millionths of a millimeter are as follows:

Microns.....	0.001 millimeter, (μ)
Millimicron.....	0.000,001 millimeter (mμ)
Angstrom Unit.....	0.000,000,1 millimeter (Å)

ELECTROMAGNETIC SERIES

The members of the electromagnetic series with their approximate wave length divisions are as follows:

Cosmic Rays	Thousandths of Å
Gamma Rays	0.001 to 0.1Å
X-Rays	0.1 to 500 Å
Ultra Violet Far	50 to 200 mμ.*

* To avoid a large number the next higher unit of measurement is taken: A millimicron equals 10 Angstrom Units.

Ultra Violet Near.....	200 to 400 mμ.
Visible Light	400 to 700 mμ.
Infra Red Near.....	700 to 1,000 mμ.
Infra Red Medium.....	1,000 to 10,000 mμ.
Infra Red Far.....	10,000 to 100,000 mμ.
Hertzian waves	Microns to meters
Radio waves	0.1 meter to infinity
Alternating current	Kilometers

Normally light travels in a straight line. Under certain conditions light may be made to suffer the following changes (7).

1. When a beam of light is projected on some object, all the light visible on this object is said to be *reflected*.

2. When a beam of light is passed at right angles through transparent mediums of different density, the beam is bent according to the laws of *refraction*.

3. When a ray of light passes a sharp edge, the margin of this ray nearest the edge deviates according to the law of *diffraction*.

4. When the rays of light are made to flow in one direction, in a single plane the light is said to be *polarized*.

Only the energy between the wavelengths 400 mμ. to 700 mμ. produces the sensation of light and color to the human eye. Sunlight and such artificial light as is produced by incandescent bodies, as the filament of an electric lamp, the gas mantle and even the carbon particles that form the flame of a candle, contain all the colors, that is to say, all wavelengths of radiant energy to which the human eye is sensitive. This may be proven by passing such apparently white light through a prism whereby the colors are separated out into a spectrum. The spectral colors with their approximate wavelength divisions are as follows:

Spectrum

Violet	400 to 470 mμ.
Blue	470 to 520 mμ.
Green	520 to 570 mμ.
Yellow	570 to 600 mμ.
Orange	600 to 640 mμ.
Red	640 to 700 mμ.

SPECTROSCOPE

The physicist devised the spectroscope to make use of this property of white light to aid him in measuring the physical properties of matter. The analysis of color by means of the spectroscope is termed "Absorption Spectroscopy". This name is particularly fitting, for when white light is transmitted through, or reflected from a color media, a selective absorption takes place, only that part of the light is measured which is not absorbed by the sample. (8)

PHOTOMETER

The spectroscope gives only the spectral quality of the color. To specify color properly, additional information is necessary. The depth of color or the intensity of the spectral radiation must be known. To measure this property the physicist developed the photometer. This instrument measured the relative intensity of the light independent of its spectral quality. (9) The two instruments, spectroscope and photometer, when used in series is the simple spectrophotometer.

SPECTROPHOTOMETRY

The field of spectrophotometry is not new. Physicists have known about and made use of this science for over eighty years. As early as 1886 Benedikt and Knecht (22) made reference to spectrophotometry as an aid to identify dyestuffs. Even with this early beginning, spectrophotometry was slow in getting its start in industry. This was not because the science was imperfect, but because the method of analysis was slow and tedious and special training was required to interpret the results. It was only with the advent of the photoelectric cell that the stature of the spectrophotometer changed from that of a laboratory luxury to that of a useful industrial instrument. The photoelectric cell provides for the standard observer independent of the human eye. When the physicist attached the photoelectric cell to the spectrophotometer, he made the photoelectric-spectrophotometer. It is in this form that the instrument is of use to the dyer because it measures color independently of personal observation. The comparative results are reproducible at all times under all conditions. Thus, once a system of this type is adopted, it will lead to the standardization of the dyeing process.

SPECTROPHOTOMETERS

There are a number of spectrophotometers available. Among the more common are: Bausch and Lomb, Hilger-Nutting, Koenig-Martens, Keuffel-Esser, Cenco spectrophotelometer, Beckman, Coleman, Harrison, Razek-Mulder, General Electric, Graham-Muller, and the Snow Duplex. Of these, Cenco spectrophotelometer, Beckman, Coleman, Harrison, Razek-Mulder, General Electric, Graham Muller, and the Snow Duplex spectrophotometers are photoelectric. Only the General Electric, Harrison, Graham-Muller and the Razek-Mulder are recording spectrophotometers. The Snow Duplex has a visible screen on which two color curves appear. The curves may be examined visually on the screen, or they may be plotted as desired.

Although it is not the purpose of this paper to discuss spectrophotometers in detail, some mention will be made regarding a few of the instruments indicated above.

First, the General Electric Recording Spectrophotometer, developed by A. C. Hardy of the Massachusetts Institute of Technology (10, 11). This instrument is most widely used in the industry today.

Second, the Coleman diffraction grating type, and the Beckman spectrophotometers. These machines are limited to transmission measurements, i.e. measuring transparent samples such as dye solutions (8).

Third, the Snow Duplex Spectrophotometer, Fig. 1 (12). A patent for this machine was granted to the inventor, Harold Snow, in 1941 (U. S. Patent 2,240,722).

Fig. 1

This machine is not yet commercially available. Early models of this instrument showed great promise. In fact, the second model made by the inventor was used to prepare this paper. How well the Duplex Spectrophotometer fits into the textile laboratory is shown by subsequent analyses. The Snow Duplex Spectrophotometer combines well known optical and television principles to give a rapid and continuous measure of color. It does this by projecting the curves of two colors on a cathode ray tube. With reference to fig. 2, the operation of the ma-

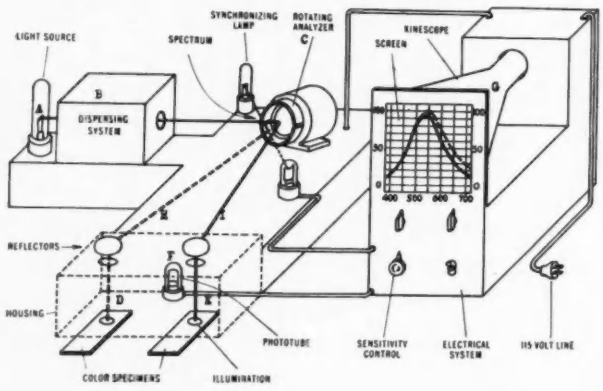


Fig. 2. Diagramatic View of the Duplex Spectrophotometer

chine may be described as follows: A suitable light source A, is passed through a dispersing system B, the spectrum thus produced is projected on a rotating analyzer C. As the analyzer spins, the light beam is alternately passed to each of the analyzing positions D and E. The light reflected from the analyzing positions is picked up by the photoelectric cell F, which transforms light energy into electrical impulses, these impulses in turn are registered on the cathode ray tube, G.

The machine is simple to operate. The left analyzing position D is usually reserved for the standard, this is called the reference beam. The reference beam is indicated on the television tube by a dotted or interrupted line. This line is referred to as the reference curve. The sample is placed in position E and is shown on the tube G as a continuous line. The reference curve can be controlled by electrical means in steps of 0.01 units, thus the operator is able to measure the color curve of a dyed sample accurately with reference to the standard color.

STANDARD WHITE

This standard may be the standard white, which consists of a block of magnesium carbonate which has been smoked with magnesium oxide. Magnesium carbonate block is smoked by burning magnesium ribbon allowing the white oxide to deposit on the surface of the block until further coating will not change the reflection of the block. This is the standard white of spectrophotometry (13). With the Duplex Spectrophotometer a color standard may also be used in the reference beam for comparative purposes.

The Duplex Spectrophotometer does the work of two spectrophotometers, it has one dispersing system, two analyzing systems and one recording system. The two spectrophotometric curves, may be compared visually, they may be plotted on paper, or any portion of the curve may be measured to determine the relative difference of two colors at any one wavelength band. All measurements in this paper are a direct comparison of two spectrophotometric curves, the curve of the standard or reference, either white or colored, and that of the sample. However, only the readings of the sample have been recorded.

The dyer can only use the spectrophotometer for his routine work if it fulfills the following two conditions:

1. A quick and reliable means of obtaining spectrophotometric data.
2. That this data may be in accord with the visual observation of the samples.
3. That results are reproducible.

Since it is the purpose of this paper to justify the use of the spectrophotometer by the dyer, let us consider how long it will take an operator to obtain the desired spectrophotometric information with the machines mentioned above.

The General Electric Spectrophotometer will draw a complete color curve in a few minutes. With the Coleman and Beckman spectrophotometers the curve has to be plotted manually. This is a slow job. However, these machines are ideal where an analysis requires one measure-

ment at one wavelength. The Duplex Spectrophotometer produces the curves of two colors instantaneously. The curves remain in position until the samples are removed from their analyzing positions. The Duplex Spectrophotometer supplies spectrophotometric data quicker than any other machine. Its instantaneous action enables the operator to compare the spectrophotometric curves of two colors as fast as colors can be compared by a visual match.

Thus with the spectrophotometric data easily obtained, the next thing to consider is how this data defines color, and how well these results compare with the sensation the colors impart to the eye.

COLOR CURVES

The spectrophotometer illustrates color in form of a graph. Abscissa or horizontal lines representing wavelengths, while the ordinates, or vertical lines measures the intensity of the spectrum for each unit wavelength (Fig. 3). In this manner a theoretical black would be

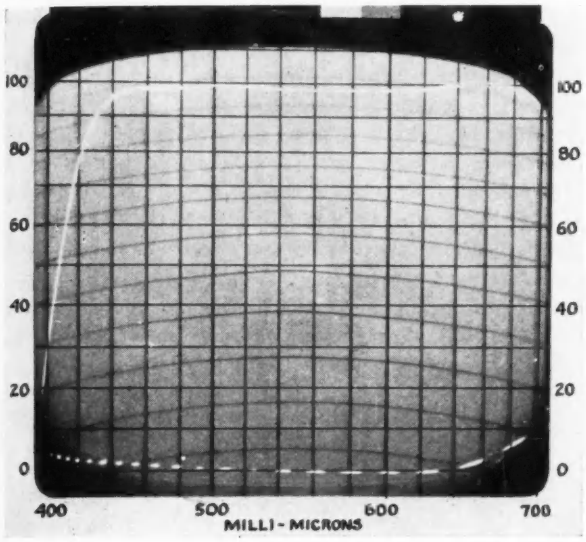


Fig. 3

represented by a straight line of "0" intensity, since black means the absorption of all light rays incident on the sample (Fig. 3, dotted line along "0" mark on the screen). Theoretical white would be represented by a straight line at "100" intensity since white light means the reflection of all light rays incident on the sample (solid line in figure 3). This is an actual photograph of the screen on the Duplex spectrophotometer with a black and white sample in the analyzing positions. The white line drops at each end, this is due to the curvature of the tube. The black has a red tone and therefore shows some red reflectance; this red is indicated by the curve turning up toward the 700 mμ. end of the spectrum.

A grey would be represented by a straight line across the spectrum somewhere between "0" and "100" intensity depending on the depth of the color. Any deviation from a straight horizontal line of reflectance would indicate the color of the sample. The dominant color is determined by finding at which portion of the graph the greatest amount of energy is indicated. The wavelength at which this occurs is called the dominant wavelength, the position of this wavelength on the spectrum indicates the color of the sample. The spectrum has already been defined, but for clearness the approximate wavelength divisions of the spectral colors will be given once more.

Violet	400 to 470 mμ.
Blue	470 to 520 mμ.
Green	520 to 570 mμ.
Yellow	570 to 600 mμ.
Orange	600 to 640 mμ.
Red	640 to 700 mμ.

COMPLIMENTARY COLORS

While the color of the sample depends on the position the peak of the dominant wavelength assumes on the spectrum, the complement of this color is indicated by finding the lowest portion of the curve. Figure 4 shows

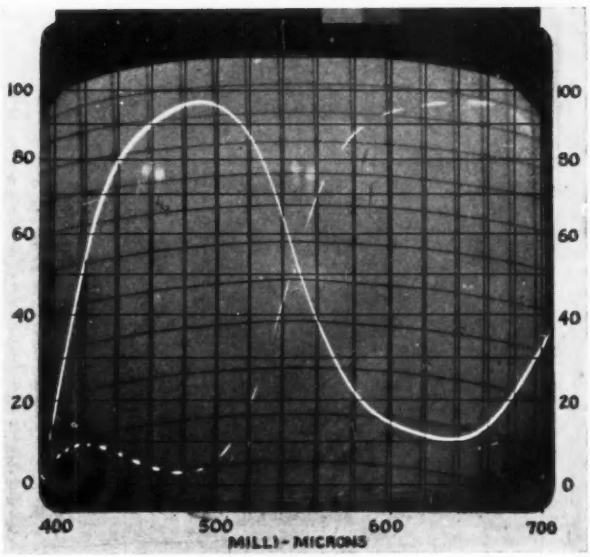


Fig. 4

the curves of a red dotted line and its green complementary color solid line. By measuring these colors against white light and plotting the curves any distortion due to the curvature of the tube is corrected, and a graph as in Figure 5 is the result.

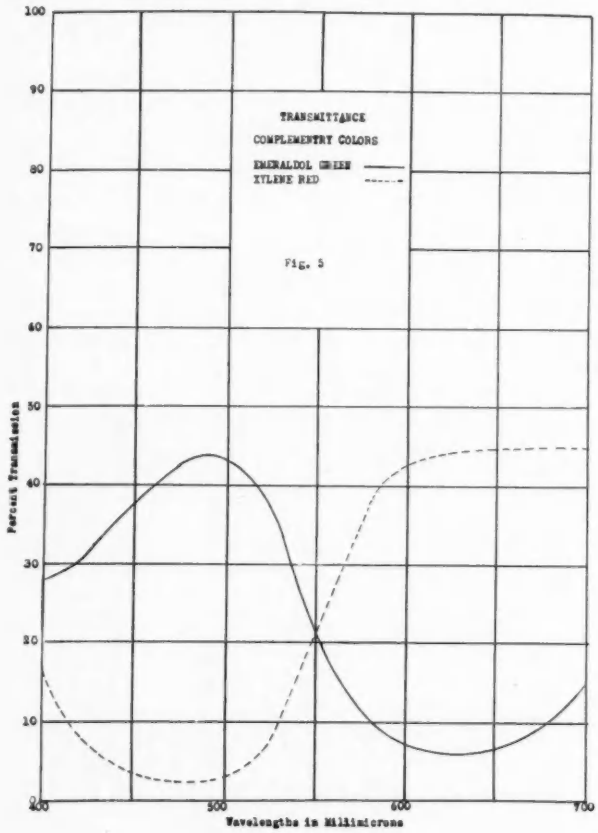
The complementary wavelength will be found convenient in measuring violets (14). Violets have two dominant wavelengths, one in the red and the other in the violet end of the spectrum. In the visible field, the dominant wavelength of a yellow is difficult to determine since this color transmits orange and red radiations as well as the characteristic yellow. The part of the yellow curve which identifies its character is the slope joining the lowest to the highest portion of the curve. Browns are characterized by a sloping line low in the violet and reaching a maximum either in the orange or red part of the spectrum. Browns may, in some instances, be classed as impure

yellows. Thus the general definition of color is shown by spectrophotometric data.

CALIBRATION OF SPECTROPHOTOMETER

When comparing two color curves the analyst must know the limits of accuracy of the instrument he is using. In general the spectrophotometer is checked for:

1. Wavelength calibration.
2. Grey scale.
3. Reproducibility.



The most convenient method of checking the wavelength scale is by using special filters whose color curves have been predetermined. A didymium glass filter, with its narrow and intense absorption bands across the visible spectrum serves as the best all purpose filter. Calibrating the Duplex Spectrophotometer with a didymium glass filter, only the 582 mμ. band need be checked. With this absorption band in its proper place the instrument is in adjustment for the wavelength scale.

To adjust the grey scale on the Duplex Spectrophotometer set the measuring device to read 100, next the curves of two standard white plates are made to coincide. Thus with one of the white plates replaced by a sample, the color curve of the sample will be plotted with reference to the standard white set at 100 per cent.

To test the reproducibility of results, one spot was measured repeatedly over a period of 9 hours. The results are shown in Table I. During the first hour the measurements were somewhat erratic. However, after this initial period of adjustment the results were more consistent.

With the results set forth in Table I the limits of accuracy, with which the Duplex Spectrophotometer will reproduce a color curve, can be calculated. Excluding the first five determinations made during the first hour, the calculations based on the remaining 15 analyses gives the following results:

The highest standard deviation is 0.05 mμ. for the 660 mμ. column or the coefficient of variation 0.258 per cent.

TABLE I

Time	660	640	620	600	580	560	540	520	500	480	460	440	420	Ave.
20 min.	19.0	15.5	12.2	10.0	8.60	8.00	7.36	6.64	6.00	5.25	4.55	4.28	4.25	8.58
30 min.	19.4	15.7	12.2	10.0	8.70	8.00	7.37	6.65	6.00	5.25	4.58	4.28	4.27	8.64
40 min.	19.4	15.7	12.4	10.0	8.80	8.05	7.42	6.70	6.00	5.30	4.62	4.32	4.30	8.70
50 min.	19.4	15.7	12.4	10.0	8.80	8.00	7.40	6.70	6.00	5.30	4.50	4.30	4.35	8.70
60 min.	19.4	15.7	12.4	10.0	8.80	8.00	7.40	6.70	6.00	5.30	4.50	4.30	4.35	8.69
1½ hr.	19.4	15.7	12.4	10.0	8.80	8.00	7.40	6.70	6.00	5.30	4.60	4.30	4.35	8.70
2 hr.	19.4	15.7	12.4	10.0	8.80	8.00	7.40	6.70	6.00	5.30	4.60	4.45	4.35	8.70
2¾ hr.	19.4	15.7	12.4	10.0	8.80	8.00	7.40	6.70	6.00	5.30	4.60	4.40	4.35	8.70
3½ hr.	19.4	15.7	12.4	10.0	8.80	8.00	7.40	6.70	6.00	5.30	4.60	4.40	4.35	8.70
4 hr.	19.4	15.7	12.4	10.0	8.80	8.00	7.40	6.70	6.00	5.30	4.60	4.40	4.35	8.70
4½ hr.	19.4	15.7	12.4	10.0	8.80	8.00	7.40	6.70	6.00	5.30	4.60	4.40	4.35	8.70
5 hr.	19.3	15.7	12.4	10.0	8.80	8.00	7.40	6.70	6.00	5.30	4.60	4.40	4.35	8.70
5½ hr.	19.3	15.7	12.4	10.0	8.80	8.00	7.40	6.70	6.00	5.30	4.60	4.40	4.35	8.70
6 hr.	19.3	15.7	12.4	10.0	8.80	8.00	7.40	6.70	6.00	5.30	4.60	4.40	4.35	8.70
6½ hr.	19.3	15.7	12.4	10.0	8.80	8.00	7.40	6.70	6.00	5.30	4.60	4.40	4.35	8.70
7 hr.	19.3	15.7	12.4	10.0	8.80	8.00	7.40	6.70	6.00	5.30	4.60	4.40	4.35	8.70
7½ hr.	19.3	15.7	12.4	10.0	8.80	8.00	7.40	6.70	6.00	5.30	4.60	4.40	4.35	8.70
8 hr.	19.3	15.7	12.4	10.0	8.70	8.00	7.40	6.70	6.00	5.30	4.60	4.40	4.35	8.68
8½ hr.	19.3	15.7	12.4	10.0	8.70	8.00	7.40	6.70	6.00	5.30	4.60	4.40	4.35	8.68
9 hr.	19.4	15.7	12.4	10.0	8.70	8.00	7.40	6.70	6.00	5.30	4.60	4.40	4.35	8.69
Average	19.35	15.7	12.4	10.0	8.78	8.00	7.40	6.70	6.00	5.30	4.60	4.39	4.35	8.69
Std. Devia. ..	.050	.000	.000	.000	.038	.000	.000	.000	.000	.000	.000	.024	.000	0.01

Solving for 660 mμ., the column of greatest observed variation.

$$v = \frac{0.05}{19.36} = 0.258\%$$

The number of tests required to achieve an Accuracy of ½%, 99 times out of 100 is calculated as follows:

$$\frac{2.576^2 \times v^2}{0.05^2} = \frac{2.576^2 \times 0.258^2}{0.05^2} = \frac{6.64 \times 0.066}{0.25} = 1.8-$$

At 660 mμ. the average of two readings is necessary to obtain the desired accuracy. At the other points of measurement the initial reading is sufficient to insure an accuracy of ½%, 99 times out of 100.

For all practical purposes the Duplex Spectrophotometer will reproduce a color curve with an accuracy of ½%, 99 times out of 100.

The number of tests required to achieve an accuracy of ½ per cent, 99 times out of 100 is 1.8. Therefore the average of two readings is necessary to obtain the desired accuracy for 660 mμ. for the other points of measurements one reading is sufficient to insure the same accuracy of 0.5 per cent 99 times out of 100. One hour warming up time is necessary before this result can be obtained with the Snow instrument.

Thus the variation in a color curve due to mechanical error, inherent with an instrument is established. On this basis only those differences greater than that of the standard error of the instrument indicates a color difference between the samples. With the Duplex Spectrophotometer the standard error is small enough to be negligible when two color curves are compared.

With two color curves easily obtained, with the curves accurately describing a color, and the limits of accuracy of the instrument known, the next question would be, how can the dyer coordinate this information with the actual observation of the color. To illustrate this point the spectrophotometer will be applied to the dyer's most important problem, color matching. Four samples of O.D. Light Serge together with two standards were selected for analysis. Each sample was considered a commercial match and represented the production of this color over a period of several months.

The color curves of dyed material are obtained by measuring the amount of light reflected from the cloth at various wavelength intervals. To measure reflectance on the Duplex Spectrophotometer, the sample is placed in position E, Fig. 2, with the standard white set in position D, Fig. 2.

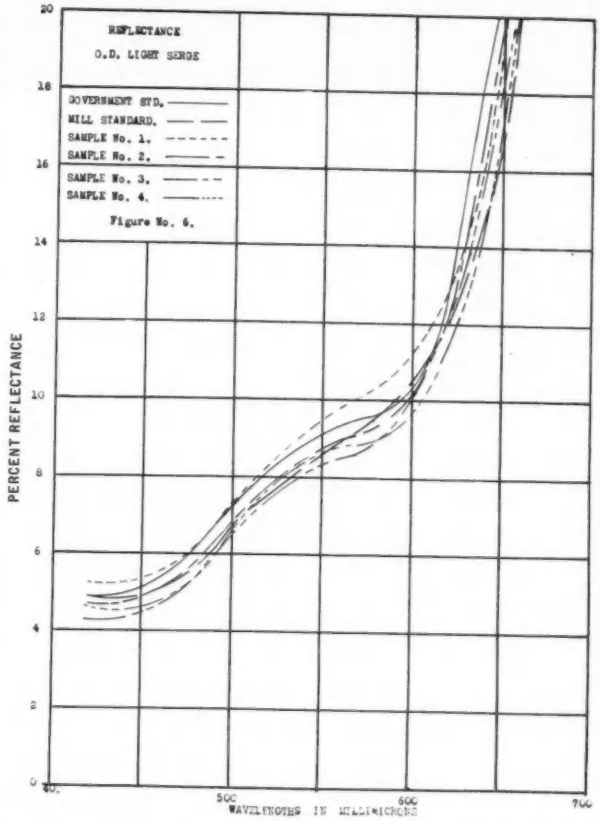
The reflectance values for the six O.D. Light Serge are shown in Table II.

TABLE II

Mμ	*U. S. Std.*	*Sple* 1.	*Sple* 2.	*Sple* 3.	*Sple* 4.	*Mill Std.*
700	34.5	34.0	33.0	32.4	34.0	32.0
660	22.7	22.0	21.7	21.0	20.0	20.0
620	13.0	13.0	12.3	12.2	11.5	12.0
580	9.6	10.3	9.2	8.9	8.9	9.6
540	8.9	9.1	8.4	8.1	8.4	8.1
500	7.3	7.4	6.8	6.4	6.5	6.7
460	5.4	5.5	5.0	4.7	4.7	5.0
420	4.9	5.2	4.7	4.3	4.6	4.9

The figures in Table II show that over a space of several months the reflectance values of samples which are considered a commercial match vary within narrow limits for each wavelength measured. All variations in the color of the sample with reference to the mill standard are in the direction of the Government standard rather than away from it. A clearer picture of the actual color differences among these samples will be obtained if the graphs of the colors are studied. The plotted curves are shown in Fig. 6.

The best way of determining color differences is by visually examining the spectrophotometric curves. However, when it comes to expressing color differences in



mathematical terms, some scheme must be devised to define the color. Most systems in use today consider three attributes for color, namely:

1. Hue or actual chromaticity.
2. Pure or impure, greyness.
3. Light or dark.

POLAR COORDINATE SPECIFICATION

The most widely used system for expressing color from color curves is described by A. C. Hardy in his Handbook of Colorimetry (15). The method describes a color as follows:

Wavelength (mμ) corresponding to the position the dominant wavelength assumes in the spectrum (hue); purity, corresponding to pure or impure (chrome); brilliance, corresponding to light or dark (value). A description of the six samples will be found in Table III.

TABLE III

Sample	*Mμ*	*Purity*	*Brilliance*
Government Std.	577.0	27.5%	9.46%
Mill Standard	576.0	27.5	8.93
Sample No. 1.....	575.5	28.0	9.81
Sample No. 2.....	577.0	29.5	9.03
Sample No. 3.....	576.0	31.0	8.72
Sample No. 4.....	572.5	27.5	8.64

A glance at Table III shows that sample No. 1 is the lightest, sample No. 2 the closest to the Government standard in color, sample No. 3 is the brightest, while sample No. 4 is the heaviest.

DESPLEDS SYSTEM

A less known, but simpler system for analyzing color curves is the one used by L. Blin Despleds (2). Here color is evaluated relative to a colored standard. In this respect it differs from the previous method where color was defined by the position it assumes in the spectrum.

The best way to describe the system of Despleds is to illustrate an actual analysis, Fig. 7.

FORSTMANN WOOLEN CO.

Govn't. Std.		Mill Standard O.D. Light Serge				Sample 1	Sample 2	Sample 3	Sample 4
mu.	Stand.		$\frac{B}{A}$x100		Shade Index				
	A	B	C	D	E	B // C	B // C	B // C	B // C
660	22.7	20.0	88.2	5.8x2/3	3.8	22.0/97	21.7/95	21.0/92.5	20/88.2
620	13.0	12.0	92.3	1.7x1	1.7	13.0/100	12.3/94.6	12.2/94	11.5/88
580	9.6	9.6	100.0	6.0x1	6.0	10.3/107	9.2/96.0	8.9/92.5	8.9/92.5
520	8.25	7.5	91.0	3.0x1	3.0	8.3/101	7.65/93.0	7.35/89	7.6/92.0
460	5.4	5.0	92.5	1.6x2/3	0.9	5.5/102	5.0/93.0	4.7/87.0	4.7/87.0
420	4.9	4.9	100.0	6.0x1/3	2.0	5.2/106	4.7/96.0	4.3/88.0	4.6/94.0
Mean Tone	10.64	9.83	94.0			10.7/102	10.1/95	9.7/91.5	9.5/89.7
Shade Index	0.0				17.5	12.5	5.7	10.8	13.4

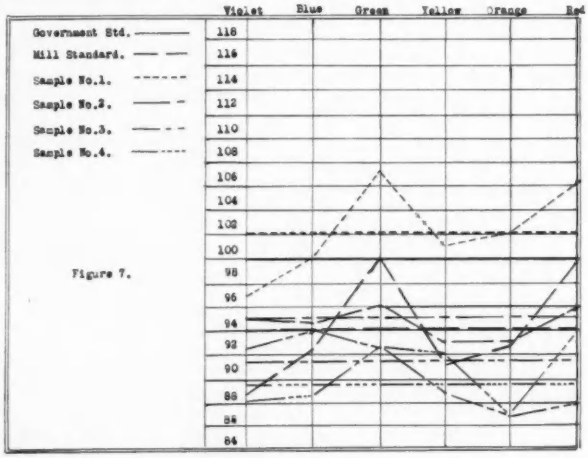


Figure 7.

The first column "A" contains the reflectance values for the Government standard. The second column "B" contains the reflectance figures for the mill standard. The figures in the third column are obtained by solving the following equation:

$$C = \frac{B}{A} \times 100$$

The mean tone in this case represents the equivalent of light or dark; it is the average reflectance for each column.

Column D is the difference between the mean tone figure and the numbers in column C. Column E is derived from column D multiplied by the necessary correction factors as set forth by L. Blin Despleds. The sum of this column supplies the shade index figure which indicates the deviation from the standard.

The straight line on the graph indicates the mean tone for the sample while the curved line shows the variation in color.

In order to be a satisfactory match a sample of O.D. Light Serge must satisfy two conditions simultaneously.

1. It must have a relative mean tone value between 87 per cent and 107 per cent.

2. The shade index of the sample must be less than 17.5 per cent, as this is the limit set by the mill standard. How well these conditions are satisfied is shown in Table IV. Compare these results with those in Table II.

TABLE IV

	$M\mu$	*Shade Index*	*Rel. Mean Tone*
Government Stand.	....	0.0	100
Mill Standard	....	17.5	94
Sample No. 1	....	12.5	102
Sample No. 2	....	5.7	95
Sample No. 3	....	10.8	91.5
Sample No. 4	....	13.4	89.7

This system lacks a brightness factor when colors like yellows, browns, or greys are considered. For colors having a definite maximum peak and a sharp absorption point the brightness factor is the difference between the peak and the absorption point.

Only continued use of each system will determine which is the better, or whether some new system will evolve which would be more convenient to use.

The samples used to show the value of reflectance measurements were taken from wool dyed pieces. A question may come up as to the choice of this type of material to illustrate the value of reflectance measurements to the dyer. The objection here may be that wool dyeings are not representative of the dyer's problem, since the final match is made by blending of the colored stock (24). Dr. Seibert Q. Duntley showed how spectrophotometric data can be used in the production and control of colored fiber blends. The results in Table II show that given the same color, measurements may be reproduced within narrow limits. The results obtained are always comparative. Finally the cause of any appreciable difference in measurements is easily traced and the reason determined. OD light serge with its rigid specifications and large production serves as the best example to show what reflectance measurements can do in the field of color matching.

DYESTUFF SHIPMENTS

The dyer has many porblems incident to the matching of color. The spectrophotometer will measure the intensity and the spectral quality of light passed through a colored solution. The color curves obtained in this manner are called "transmittance curves". Hence, the instrument provides an excellent means to evaluate the relative strength and shade of dyestuff shipments. The following facts should be recalled to fully appreciate the value of this information. The cost of acid and chrome colors generally range from $0.25 to $5.00 per lb. To realize full value from the coloring matter, it must be uniform in strength. If the dyer receives a weak shipment it means an actual loss in money. Aside from the monetary stand-

(Continued on page 17)

PROCEEDINGS OF THE
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JANUARY 4, 1943

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DISCUSSION*

Following Talk by Arnold L. Lippert on Conservation Order M-103 before the New York Section on November 6, 1942.

Mr. Brook: May I ask, why the rule that would preclude the use of an allotment of the preceding quarter in the succeeding quarter?

Dr. Lippert: We have had that under consideration, sir, and one of the contributing factors against that particular rule is the fact that we find some difficulty of enforcement under our present regulations. If that were also included, we have felt that perhaps it would be too complicated to administer and enforce.

Mr. Brook: Well, I don't quite get that. I mean, if the object is to conserve the use of dyestuffs, and if the allotment that a dyer is entitled to use be a given figure, and since he does not control production in the processing of materials that are sent to him, it may so happen that in a given quarter it may fluctuate and be just a little under the figure that he would be entitled to use; whereas in the succeeding quarter he might experience a shortage and he would be handicapped, of course.

Dr. Lippert: That has had some consideration on our part. However, you have two factors which must be considered. One is that a manufacturer who, being thrifty enough to save dye, perhaps, would be far ahead of his competitors. Another is that there is great difficulty in policing and regulating an order of this type, and in order to do that in the simplest possible way, we have so far written the provisions so that these quotas cannot be carried over from quarter to quarter.

Mr. Dogin: Take a firm starting in business January 1, 1942. They have to base their requirements on the previous year. What recourse has that particular firm?

Dr. Lippert: Well, Mr. Dogin, if you will refer to Conservation Order M-103, paragraph (k), that firm has the recourse of filing an appeal to the Dyestuff Section of the War Production Board. Each appeal is considered on its own merits. There have been such appeals. They have been considered on their own merits, and some basis for their quota is established upon the data which is presented.

Mr. Baumann: Dr. Lippert, there has been some misunderstanding, and I have heard different answers from different dyestuff concerns. We would like to know whether we can use our vat Anthraquinone quota for acetate colors.

Dr. Lippert: You cannot. The answer is no. I might add one thing, while I am on the floor. This isn't one of the basic principles of Conservation Order M-103, but it is one of its provisions and that is, in the last paragraph we have made the following statement:

"The provisions of the Order applicable to dyestuffs appearing on List A apply to all dyes listed above or their equivalents, which shall not apply to compounds of such dyes and other Anthraquinone vat dyes in which the content of such dyes is not in excess of 10 per cent."

That means simply this: that if you have an Anthraquinone vat dye which is a mixture, part list "A," part not list "A," you can have list "A" dye in the mixture up to and including 10 per cent and not have the final mixed dye considered a list "A" dye under Conservation Order M-103. However, any mixture of Anthraquinone vat dye, irrespective of its content, any mixture of other Anthraquinone colors, irrespective of their content, come within the provisions of Conservation Order M-103.

Mr. Dogin: By "other Anthraquinone dyes," Doctor, do you mean the acetate colors?

Dr. Lippert: Acetate and alizarin.

Mr. Dogin: In other words, we can make up an acetate ground, for instance, using up to 10 per cent.

Dr. Lippert: No, you cannot. In other words, this mixture ruling allows Anthraquinone vat dyes list "A" up to 10 per cent in a mixture of vat dyes, and not having the mixture considered list "A," in other words, not restricted to military use only, it still is within the provisions of the Order. Any mixture of acetate colors, Anthraquinone types, alizarin colors, etc.

Mr. Dogin: Does not apply?

Dr. Lippert: Does apply.

Mr. Rose: I notice in the orders as written now, you refer to the Anthraquinone vat dyes in terms of single strength vat and in other Anthraquinone notices in terms of pounds. If I understand correctly, would it be possible for a person to put out a 300 per cent color where they originally sold a 100 per cent color, where you are going to figure the quota on a poundage basis?

Dr. Lippert: Mr. Rose, that question has bothered us at some length, and we have reason to believe, from the data which has been submitted by various dyestuff manufacturers, that there are recognized standards of single strength Anthraquinone acetate dyes. We believe that one single strength dye, pound for pound, is equivalent to another. In other words, if you put out a 200 per cent Anthraquinone acetate dye, it is equivalent to two pounds of the single strength.

Perhaps the point should be clarified but that is the way the interpretation is made.

Mr. Rose: May I continue that thought a little further, Doctor? Inasmuch as you say there has been no standard set up for the Anthraquinone dyes other than the vat dyes, I mean, referring to the poundage basis—

Dr. Lippert: For instance, the United States Tariff Commission recognizes Anthraquinone single strength vat pastes as a standard. They have no recognized standard for Anthraquinone acetate colors. However, I believe that you and your competitors know what is a single strength acetate color.

Mr. Rose: May I continue with what I was trying to get at? Suppose, Doctor, that you have a mix of acetate

*Dr. Lippert's address was published in the Proceedings on November 23, 1942.

dyes in which the Anthraquinone content, on the basis of single strength, was 10 per cent. You would include that as an Anthraquinone dyestuff, is that right?

Dr. Lippert: That is correct.

Mr. Rose: If that mix was taken apart, let's say it consisted of three components, then the color itself, could be sold, and the other components which enter into the mix could be sold separately. In that event, a man actually could purchase 10 times as much Anthraquinone dyes as he would have if he bought the mixed one.

Dr. Lippert: No, that isn't the way we interpret it.

Mr. Rose: But it could be done, isn't that right, Doctor? (Laughter)

Dr. Lippert: It could be done, but we would consider it a violation. (Laughter and applause) In other words, we look upon that in a similar way that we look upon strength of dyes. In other words, there are some vat colors that we want to compare Anthraquinone vat colors with as acetate colors which are, let's say, 10 times the single strength basis. If a man buys one pound of that, he is using up really 10 pounds. If he buys a dye which is 10 per cent Anthraquinone acetate color, he is using up 1/10 of a pound.

Mr. Rose: That is just my point, Doctor. I am talking from the point of view of conserving these Anthraquinone dyestuffs. A man who is buying a brown that is a mixture could in turn replace it with a blue, and then make all the brown that he needed and still have plenty of blue left over. He would still not be invalidating the terms of the order, isn't that so?

Dr. Lippert: No, I don't believe it is.

Mr. Rose: But if you say that one pound can be substituted for another, regardless of color, that actually can be done.

Dr. Lippert: Well, I don't know whether I said pound for pound. It all depends on what is in the particular mixture. In other words, you can sell a customer a straight Anthraquinone type; he can mix it, if he wants. Or, you can sell him a mixture already mixed. For instance, if you sold him one pound of Anthraquinone blue, 9 pounds of an Azo type color, you would be selling, he would be buying, one pound. If you sold him 10 pounds of that color, as such, you would be still selling one pound, he would be still buying one pound. (Applause).

This Order applies to Anthraquinone derivatives only, not to Azo types.

Mr. Baumann: There are colors that sell for 50 cents and some that sell for $5.

Dr. Lippert: That depends on concentration.

Mr. Baumann: We don't know when we buy it.

Dr. Lippert: Your dyestuff companies will tell you.

Mr. Bostick: As long as metatoluene diamine has been frozen by the Government, a finishing company that has a contract and supplies Government orders with metatoluene diamine would then have to substitute metaphenylene diamine and if the tests on the MTD have been approved, and there is a difference in shade or fastness, who is supposed to be behind the eight ball? (Laughter).

Dr. Lippert: Well, it is a question there of whether we are going to have explosives or MTD, and I don't think there is any doubt that the answer is that we are going to have explosives. (Applause).

Mr. Bostick: Don't forget that we may have a contract from the Army or the Navy, and we have to meet specifications. We have already been meeting those specifications. Suppose some dyer says, "Your shade doesn't match or meet specifications." We know it is going into explosives. What are we going to do? After all, we are only the poor dyer.

Dr. Lippert: Have you talked to your procurement officer yet?

Mr. Bostick: No, I am just asking the question.

Dr. Lippert: I think you will find him reasonable. Furthermore, as I pointed out before, there is still paragraph (k) in which you may appeal to the War Production Board.

Mr. Linberg: You state in your Order M-103 that a customer may buy from whom he pleases if he has the proper priority numbers and the rest of the list.

Dr. Lippert: That is correct, providing he has the money. (Laughter).

Mr. Linberg: They all seem to have it now. But, at the same time, the manufacturer of dyestuffs, because he hasn't sold that man, cannot sell that man any in that particular quarter.

Dr. Lippert: That is not correct. He may wish to run his own business that way. We have no regulation over that. We prefer not to tell him what he should do. We simply write a regulation. If he wants to run his business that way, that is up to him.

Mr. Linberg: But if a man wants to buy, wants to change his source of supply, the supplier can't give it to him, because he hasn't sold him any.

Dr. Lippert: Well, I believe that there are other suppliers who may be new to this particular mill, who would be glad to get the business. I might mention on that point also, paragraph (k) still exists in the order.

Mr. Knights: Dr. Lippert, I think the point this gentleman wanted to bring out is the point that I have in mind. Assume that a mill has a permissible quota of certain restricted dyestuff, whether it be list "A" or Anthraquinone vats other than list "A," or other Anthraquinones, and he has reason to change his source of supply. I have understood that it is possible for that customer to buy his dyes from another source, provided he is willing to submit to the second supplier a statement that he is operating under his quota and under the restrictions of M-103.

Dr. Lippert: That is right.

Mr. Knights: I think that was the point. I would like to ask the Doctor what form of certification or coverage is necessary for the second supplier to hold to cover that?

Dr. Lippert: I will have to go back to Conservation Order M-103 again. It says, in effect, in paragraph (i) that the dyestuff supplier, if he knows that a particular consumer is violating, he may also be an accessory to that violation. We have suggested that the dyestuff manufacturers, producers, or sellers, whatever the case may be, require their customers who purchase Anthraquinone dyes to state on their purchase orders a sentence—or similar sentence—such as this:

"This complies with Conservation Order M-103."

Mr. Knights: Do I understand that if the second supplier has not on his own records proper reference to show his right to supply, that such a statement would entitle him to fill that order?

Dr. Lippert: Not necessarily. Of course, the supplier to whom you might go might have his quota already filled. If that were the case, of course, he could not supply that particular order.

Mr. Knights: I didn't understand that a supplier had a quota.

Dr. Lippert: He does. (Laughter). In other words, a textile mill, since you are mostly interested in textiles, has two quotas: the quota of purchase and the quota of use. The dyestuff producer, a seller, has quota on his sales. I might add that any failure of consumer mills to obtain their quotas under this Order should be brought to our attention. We have no direct knowledge, or no specific knowledge, that a consuming mill, with an unfilled quota, has been unable to get that quota filled because of the provisions under M-103. There may be other reasons, but we have no knowledge that it is because of these provisions.

Mr. Dogin: Can a color a half of 100 per cent be classified as two pounds for one?

Dr. Lippert: Will you repeat that, please?

Mr. Dogin: Take your 100 per cent type of blue. A customer is readily supplied by a half of that 100 per cent, or a 50 per cent type. Is he allowed two pounds for the one pound?

Dr. Lippert: If your producer considers that as one-half to the recognized industry standard of a single strength, he is entitled to two pounds. It would be obvious to accept this interpretation because the consuming mill could buy a concentrated type and mix it himself.

MEETING, RHODE ISLAND SECTION

THE latest meeting of the Rhode Island Section was held on Nov. 27th in the hall of the Providence Engineering Society. An open forum was conducted on the subject:

"The employment of women in the textile industry to replace men who have entered the Armed services"

After introductory remarks by Howard V. King, Chairman, the subject was briefly discussed in prepared talks by speakers from the following divisions: Cotton Piece Goods, Harold B. Sturtevant; Worsted, Carl Medde; Cotton Yarns, Thomas Goulet; Woolen, Charles Sedgwick; and Training of Women, Wm. D. Fales, R. I. School of Design. The discussion was ably conducted by Mr. Sturtevant and the urgency and importance of the matter was made quite evident.

Motion pictures on football shown by Roland Brown, Line Coach at Brown University, followed. The attendance was 50, and the meeting lasted until 10:30 p.m.

Respectfully submitted,

R. W. JOERGER, *Secretary.*

MEETING, SOUTH CENTRAL SECTION

THE December meeting of the South-Central Section was held at the Read House in Chattanooga, Tennessee Saturday, December 12th. A paper was presented by W. J. Harrison of the Trion Company entitled "Effect of Present War on Hosiery Dyeing."

The election of officers for 1943 was also held.

Chairman—Jack Anderson, Peerless Woolen Mills.

Vice-Chairman—W. J. Harrison, Trion Company.

Secretary—Homer Whelchel, Central Franklin Processing Company.

Treasurer—Marvin Moore, Hosiery Processing Company.

Councilor—W. J. Harrison, Trion Company.

Sectional Committee: Walter E. Hadley, Standard-Coosa-Thatcher Company, National Plant; W. S. McNab, Quaker City Chemical Company; W. A. Bentel, Burkart-Schier Chemical Company; Nestor Grotelueschen, Magnet Mills.

It was decided to continue holding a regular quarterly meeting. The date of the next meeting will be announced later.

Respectfully submitted,

GEORGE S. MCCARTY, *Secretary.*

MEMBERSHIP

APPLICATION BLANKS

for individual

and corporate

MEMBERSHIP

may be obtained

from the secretary

Dr. H. C. CHAPIN

Lowell Textile Institute, Lowell, Mass.

MEMBERSHIP APPLICATIONS

Corporate

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Senior

Peter Arkin—Foreman Dyer, W. M. Gotsch Co., Chicago, Ill. Sponsors: L. R. Fox, C. M. Robbins.

John F. Ash—Supt. and Chemist, Soluol Corp., Natick, R. I. Sponsors: J. G. Nathanson, H. G. Macdonald.

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James E. Briggs—Laboratory Asst. and Dyer, Sanford Mills, Sanford, Maine. Sponsors: S. Sylvester, E. S. Chapin.

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Harry Sankey—Dyer, Hope Webbing Co., Pawtucket, R. I. Sponsors: R. W. Joerger, H. V. King.

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Robert D. Walker—Asst. Supt., Finishing and Dyeing, Drexel Knitting Mills Co., Drexel, N. C. Sponsors: M. Mackenzie, H. A. Walker.

William Harold Wisdom—Owner and Research Colorist, California Color Co., Glendale, Calif. Sponsor: J. E. Meili.

George G. Wunsch—Night Supt., Hellwig Silk Dyeing Co., Philadelphia, Pa. Sponsors: A. W. Etchells, A. V. Morrell.

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Junior

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William D. Cuthbertson—Apprentice Dyer, Hope Webbing Co., Pawtucket, R. I. Sponsors: H. V. King, R. W. Joerger.

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Archibald Warren Fisher—Textile World, New York, N. Y.

Roland N. Genest—Junior Chemist, Quartermaster Depot, Philadelphia, Pa.

Luis E. Herrera—Student of Dye Application, E. I. du Pont de Nemours & Co., Inc., Technical Laboratory, Wilmington, Del.

Gabriel M. Lanata—Student of Dye Application, E. I. duPont de Nemours & Co., Inc., Technical Laboratory, Wilmington, Del.

William M. Nixon—Vice Pres. and General Manager, Atlanta Woolen Mills, Atlanta, Ga.

Curt Richter—Vice President, in charge of manufacturing, S. Stroock & Co., Newburgh, N. Y.

Adolph C. Wiese—Weehawken Piece Dye Works, Weehawken, N. J.

Student

Charles T. Allen, Jr.—New Bedford Textile School, Sponsor: Francis Tripp.

William L. Benson—New Bedford Textile School. Sponsor: Francis Tripp.

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John M. Pharr—North Carolina State College. Sponsor: A. H. Grimshaw.

Roger Castle Griffin, Jr.—Lowell Textile Institute. Sponsor: Louis A. Olney.

CALENDAR OF COMING EVENTS

Meeting, Northern New England Section, Engineers' Club, 2 Commonwealth Ave., Boston, Mass., January 15, 1943. Program—Remarks by Thomas R. Smith, national president; Presentation of New York Section prize-winning paper; Presentation of completed Northern New England Section prize-winning paper; Report of Wm. D. Appel, chairman of Committee on Fastness to Light; General Discussion.

Council and Research Committee Meetings, Engineers' Club, Boston, Mass., January 16, 1943.

Meeting, Philadelphia Section, January 22, 1943.

Meeting, Rhode Island Section, January 22, 1943.

Meeting, New York Section, Downtown Athletic Club, New York City, January 29, 1943. Subject: "Application of Resins and Plastics to Textiles." Speakers: Carl W. Patton, Carbide & Carbon Chemicals Corp., Plastics Division, "Application of Vinyl Resins and Plastics to Textiles" and William H. Butler, Bakelite Corp., "Phenolic Resins, Resin Emulsion Coatings, and their Application to Textiles."

General Business Meeting (in conjunction with New York Section meeting) April 16, 1943, New York City.

Council and Research Committee Meetings, April 17, 1943, New York City.

UNEMPLOYMENT REGISTER

Members of this association, who are without employment, should forward a statement as to their qualifications and experience. This information will subsequently appear on these pages with an identifying key number. Employers are also requested to file with the American Dyestuff Reporter any vacancies which may occur in their business.

NOTICE TO EMPLOYERS

Personal Histories and Employment Records of the following applicants are on file at the office of the American Dyestuff Reporter. Prospective employers may examine them without obligation.

Key: A—Laboratory and research; B—Dyeing or printing; C—Finishing; D—Sales; E—Instruction; F—Executive.

NOTE: PERSONS WHO HAVE OBTAINED EMPLOYMENT SHOULD NOTIFY THE AMERICAN DYESTUFF REPORTER AT ONCE.

A-3

Education—B.S. in chemistry, Lehigh University.

Experience—Experimental engineer and analytical chemist, 8 mos.; assistant superintendent of silk corporation, assisted in planning and directing production, in charge of laboratory, technical work, personnel, purchasing, etc., 2 years; inspector of ordnance material, to the present. Seeks position as chemical engineer or chemist.

Age 25; single; references.

A-B-18

Education—Graduate Philadelphia Textile School, 1940.

Experience—Has experience as assistant chemist and trouble shooter in silk dyeing and finishing plant; as manager of laundry store; and as printer and colorist in screen printing plant. Seeks position in laboratory and research, dyeing, printing or finishing

Age 21; single; references.

A-B-C-F-3

Experience—Broad experience since 1906 as overseer of finishing, general researcher, trouble shooter, overseer of dyeing, general superintendent, mill manager. Experienced in woolen, worsted, cottons, unions and mixtures. Recently specialized in men's wear cottons. Seeks position as overseer of finishing or dyeing, assistant superintendent, superintendent or manager.

Age 53, married; references.

B-10

Education—2 years chemistry, 2 years textile chemistry and dyeing, Lowell Textile Institute, evenings.

Experience—4½ years dyeing and bleaching hosiery, specializing in children's and infants' hose; 3 years assistant dyer, dyeing and bleaching cotton, mercerized and unmercerized, wool, wool-cotton, wool-rayon and wool-silk hose. Seeks position as second hand, assistant dyer or laboratory assistant in hosiery mill.

Age 27; single; references.

B-D-1

Education—High school graduate; textile chemistry, Textile Evening High School, New York City; accounting; typist.

Experience—from 1935 to present employed as colorist with screen printing plant in New York City. Experienced with all types of fibers and all types of dyes. Shade matching. Versed in accounting, typing, modern office procedure and sales promotion. Able assistant to busy executive. Age 46; single; references.

C-1

Experience—Experienced as assistant finisher, finisher and superintendent of finishing since 1923. Experience on automobile cloth, boucle overcoatings, high grade men's wear worsted, low grade woolens, medium grade plaid-back overcoatings, fleece finish overcoatings, Bolivias, kerseys, medium-grade men's piece dye suitings, uniform cloth, flannels, ladies' dress goods and coatings, government serge and elastique fabrics, marine wool, flannel shirtings.

Age 37; married, 3 children; references.

THE SPECTROPHOTOMETER

(Continued from page 8)

point any appreciable difference in strength or shade of the dyestuff requires a revision of the dyer's formula. Hence the necessity for testing each batch of color entering the mill.

The method of testing consists of making parallel dyeings of both the standard and the shipment, then comparing the finished dyeings visually. This procedure consumes both time and matreial. The final result based as it is on a visual inspection is subject to all errors common with this type of evaluation.

The concentration of a dye in solution is easily and accurately determined by use of transmittance measurements. The procedure is simple and is divided into two parts:

1. Preparation of the sample
2. Measuring the sample and calculating the results.

The samples are prepared by making two similar solutions, one of the standard and the other representative of the shipment. The samples are now ready to be measured.

To prepare the spectrophotometer for transmittance work, two matched white plates are placed in analyzing positions D and E Fig. 2. A glass cell filled with the prepared dye solution is placed in position "I" Fig. 2. To cancel the effect of absorption due to the glass cell and the solvent, usually distilled water and buffer, a similar cell filled with the buffer is placed in the reference beam, position H, Fig. 2. The samples are now in place to be analyzed. The standard is measured with each analysis.

Only one measurement at one wavelength is necessary to determine the concentration of a dyestuff. The lowest portion of the color curve is determined. This is the observed intensity for one wavelength for this color. When the observed intensity at one wavelength for both the standard and the shipment is known, the ratio of the concentration between the two can be calculated by using the following formula: (16)

CONCENTRATION OF DYESTUFF

$$\frac{\text{Standard log Io/I}}{\text{Shipment log Io/I}} \times 100 = \text{parts of the shipment equivalent to 100 parts of the standard}$$

The strength of a shipment is expressed as a ratio with the standard equal to 100.

For example consider the fourth sample in Table V.

Observed intensity for the standard 44 per cent at 570 mμ.

Observed intensity for the shipment 43.5 per cent at 570 mμ.

The original intensity (Io) is equal to 100.

Then:

$$\frac{\log 100/44}{\log 100/43.5} = \frac{0.356}{0.362} = 0.985$$

0.985 x 100 = 98.5 parts of the shipment are the equivalent of 100 parts of the standard.

This formula holds only if the values for the observed intensity are taken at the same wavelength for both the standard and the shipment. The wavelength being that of maximum absorption. For best results the dye solution should be buffered at a definite pH value. The pH can be ascertained by experimentation. The formula works best with dilute solutions where the absorption point has a transmittance ranging from 15 per cent to 45 per cent. Any coloring matter which forms a true and stable solution can be measured by this method.

The results obtained by spectrophotometric analysis of a number of shipments of a Black Pr. 143 is shown in Table V.

TABLE V

Sample	*660 mμ.*	*570 mμ.*	*460 mμ.*	*Strength Ratio*
Standard	80.0	44.0	60.0	100.0
67 332	79.0	43.0	59.0	97.0
67 347	80.0	44.0	60.0	100.0
67 349	80.0	44.0	59.0	100.0
67 350	80.0	43.5	59.0	98.5
67 351	80.0	43.5	59.0	98.5
67 973	80.0	43.0	59.0	97.0
67 974	79.0	44.0	59.0	100.0
67 972	79.0	43.0	59.0	97.0
72 970	81.0	43.0	60.0	97.0
72 971	80.0	43.0	60.0	97.0
72 972	80.0	43.0	60.0	97.0
72 973	81.0	43.0	60.0	97.0
72 974	81.0	43.0	60.0	97.0
72 975	80.0	43.0	60.0	97.0
72 976	80.0	43.0	60.0	97.0
72 977	80.0	43.0	60.0	97.0

Table V represents a dyestuff delivered uniform in concentration. It is to the credit of the dyestuff industry that they are able to supply so uniform a product. This reflects the care the dyestuff manufacturer takes to satisfy their customers. At the same time the dyer is aided materially by being supplied with a standardized coloring matter.

Unfortunately all dyestuffs are not constant batch for batch. Dyestuff shipments vary in two general ways. The first and most frequent variation is one of strength, while the second variation is that of shade difference.

To show how spectrophotometric data can be used to find a difference in the concentration of a dye, a typical analysis is given in Table VI.

An analysis of a chrome orange:

Sample No. 3 is approximately 22 per cent weaker than

TABLE VI

Sample	600	500	400	*Strength Ratio*
1	99	89	25	100
2	99	88	25	100
3	98	80	30	122

either of the others. This was a former standard for this color. The new standard (Sample 1) is 20 per cent stronger than the old, according to the claim of the manufacturer. The spectrophotometer shows this increase. The new shipments agree with the stronger standard.

In most instances the deviation in color of a shipment is not serious. However, there are cases where the color difference is great enough to ruin the dyer's formula. Consider the case of the chrome grey which came to the mill off-shade. Here the color of the shipment had little resemblance to the standard the dyer had for this color. The manner in which the shipment and the standard analyzed on the spectrophotometer is shown in Table VII.

The shipment in this case was dull when compared to the standard. See Graph in Fig. 8.

In a woolen mill there are few dyestuffs which have not yet been adapted to spectrophotometric measurements.

Eriochrome Brilliant Violet B seems to be one of these colors. The dye does not form a true solution. For the sake of illustration six solutions of this color were prepared, three of the standard, and three of the shipment. The results are shown in Table VIII.

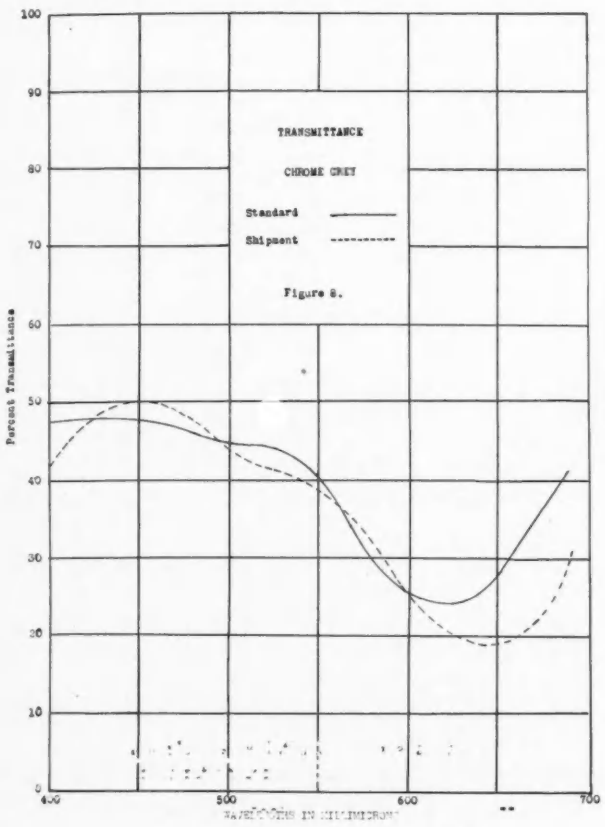
TABLE VII

Mμ.	*Standard*	*Shipment*
690	30.0	42.0
660	19.0	31.0
630	19.0	24.5
600	25.0	25.0
570	33.5	32.5
540	40.0	42.0
510	43.0	44.3
480	46.3	66.3
450	50.0	47.5
420	47.0	48.0

TABLE VIII

Mμ.	*Std.* 1	*Std.* 2	*Std.* 3	*Sample* 1	*Sample* 2	*Sample* 3
700	90.1	91.0	92.0	95.0	92.0	96.0
660	90.0	91.0	92.0	95.0	92.0	96.0
620	81.0	83.0	84.0	92.0	87.0	90.0
580	65.0	70.0	72.0	86.0	77.0	79.0
540	57.0	62.0	65.0	81.0	69.0	74.0
500	51.0	57.0	60.0	75.0	63.0	67.0
460	48.0	51.0	54.0	65.0	56.0	62.0
440	46.0	50.0	52.0	63.0	65.0	61.0
420	46.0	50.0	52.0	62.0	54.0	62.0

In this case each set of solutions vary considerably within themselves. The curves of these colors are shown in Fig. 9. Apparently the discrepancy in color does not appear in the finished dyeing as seen by the reflectance figures in Table IX.



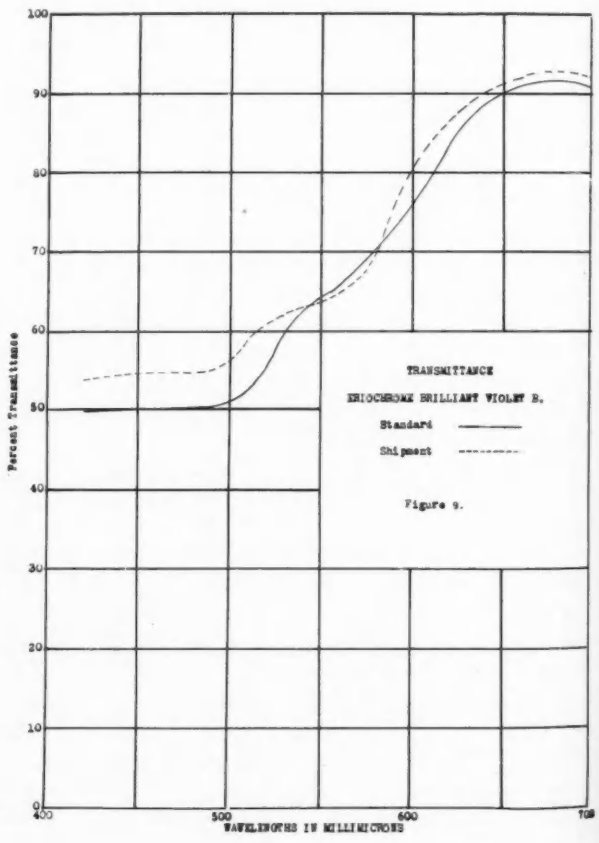
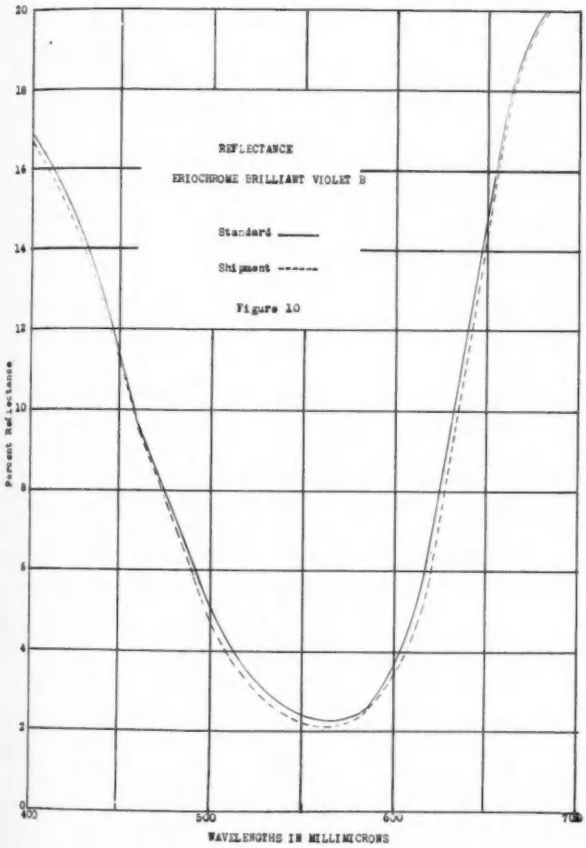


TABLE IX

$M\mu$.	Standard	Shipment
700	29.0	28.0
660	17.5	16.5
620	6.7	6.3
580	2.4	2.4
540	2.6	2.4
500	5.0	4.6
460	9.6	9.7
420	14.3	15.0

This shipment is brighter and slightly heavier than the standard. This is shown by the graph, Fig. 10.



The analysis mentioned above were chosen as representative of the variations occurring in the dyestuffs the dyer receives. It has been pointed out that the spectrophotometer can only be used to measure any difference in color or concentration of a shipment with reference to a standard. In addition spectrophotometric curves show all causes for color differences (impurities, etc.), between two dyestuffs. In this respect it is superior to the dyetrial method, since by dyeing out, only those differences exhausted by the dyebath are apparent. Yet impurities in dyestuffs may lead to difficulties, during a dyeing process. Thus spectrophotometric data offers the dyer a working knowledge of his coloring matter with an accuracy impossible by any other means of comparison in use today.

EXHAUSTION RATES

By minimizing the error introduced by variation in dyestuff shipments, the dyer gains uniformity with the starting bath.

Through the study of the exhaustion of a dyestuff, the dyer can use the spectrophotometer to follow the entire dyeing process. Thus the dyer can determine the condition of the dyebath every time he receives a sample to match. This information will aid the dyer with the problem of shade correction. To do this efficiently the dyer must be sure that the material will not pick up any more color from the bath, in other words the dyebath must be exhausted. Since the full shade of a formula is not developed until the dyebath is completely exhausted, any attempt to correct the shade before this condition is reached will lead to an error.

The spectrophotometer defines the exhaustion rate of a dyestuff quite accurately. The procedure consists of determining the concentration of the dyestuff in the initial bath. Then finding the amount of color remaining after the operation is completed. Then determine the amount of color absorbed by the material. Some results using this procedure are shown in Table X.

TABLE X

Dyestuff	Initial Bath	Exhausted Bath	% Exhaustion
GI 247	0.16 gm.	0.0037 gm.	97.8
GI 247	0.16 gm.	0.0032 gm.	98.0
GI 247	0.18 gm.	0.0032 gm.	98.3
Pr. 4	0.18 gm.	0.014 gm.	91.6
Pr. 4	0.18 gm.	0.016 gm.	91.7

Table X shows that under certain dyeing conditions the material will take approximately 98 per cent of the black from solution. Obviously any attempt to correct the color of the material until 98 per cent of the dyestuff is removed from the liquor will lead to an error. The dyer, by checking the progress of a dyeing with the spectrophotometer, has an absolute measure on the exhaustion of a dyestuff. This procedure enables the dyer to study the effect of pH, dyeing assistants, and temperature on the exhaustion rate of the dyestuff.

NEW DYESTUFFS

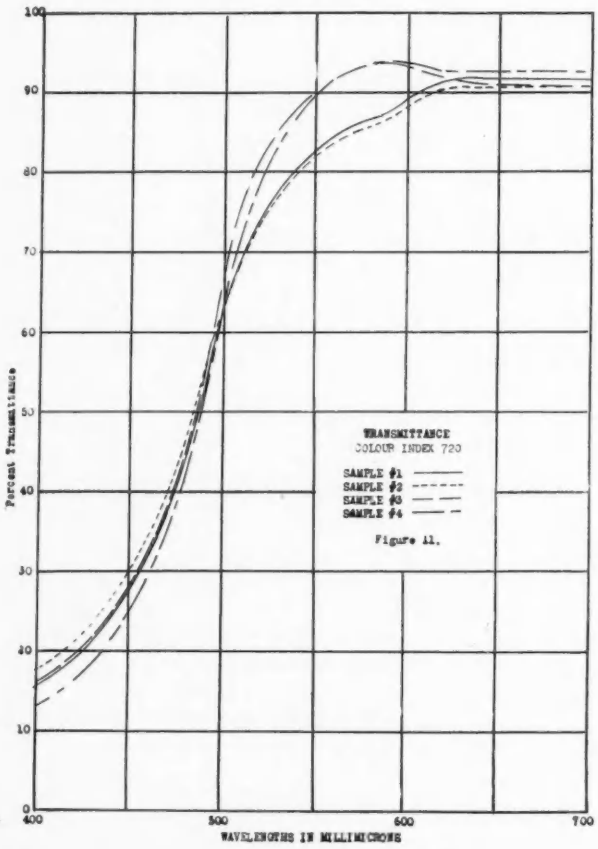
The manufacturers of dyestuffs are continuously offering new products to the textile industry. The sorting out of a suitable dyestuff is no easy task, since the dyeing out of these colors to a standard takes considerable time. The spectrophotometer makes this job easier for the dyer. It has proven that the spectrophotometer offers an easy reference to the shade and concentration of a dyestuff. The first consideration of the dyer when selecting a new product is to get as close as possible to the standard. By a preliminary inspection of this product with the spectrophotometer the dyer can reject the samples which offer the least promise, and reserve for further testing those samples which compare favorably with the standard.

For example, the comparison among four chrome blues is given in Table XI.

TABLE XI

Mμ.	*Sample 1*	*Sample 2*	*Sample 3*	*Sample 4*
700	92.0	91.0	91.0	93.0
660	92.0	91.0	91.0	93.0
620	92.0	91.0	92.0	93.0
580	87.0	86.5	94.0	94.0
540	81.0	80.0	89.0	87.0
500	62.0	64.0	66.0	63.0
460	32.0	35.0	33.0	29.0
420	19.0	21.0	19.0	16.0

The blues are of the Azurol BX type, Colour Index No. 720. The manufacturers consider these dyes to be interchangeable. The color curves, Figure 11, show this. In addition the curves group the dyestuffs into pairs.



Samples 1 and 2.....Dull Shade

Samples 3 and 4.....Bright Shade

The chrome blues of this class in the undeveloped stage are yellow in solution, as the color curves indicate. The curves of the dull group show the influence of a blue impurity. The bluish shade is most pronounced in the dyeing, before chroming. When these colors are oxidized with chrome, samples 1 and 2, containing this impurity, are dull and flat when compared to samples 3 and 4. This is shown by the reflectance curves, Table XII, figure 12.

The figures tabulated in Table XII are five times the observed value. These values are in accord with the graph, Figure 12.

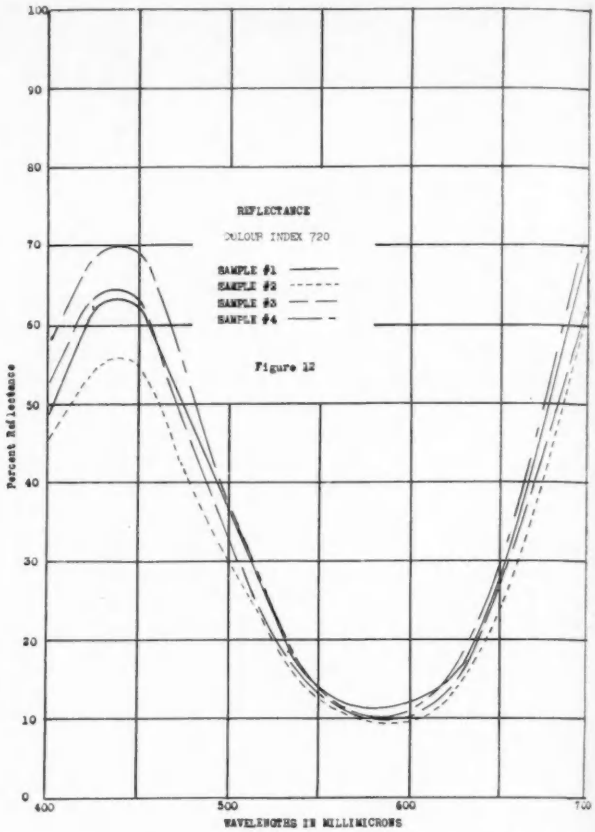


TABLE XII

Mμ.	*Sample 1*	*Sample 2*	*Sample 3*	*Sample 4*
700	70.0	63.0	63.0	73.5
660	36.5	30.5	35.0	39.0
620	14.0	11.5	12.5	13.5
580	11.5	9.8	10.2	10.0
540	17.5	14.5	16.0	17.0
500	34.0	30.5	32.5	36.0
460	55.0	52.0	57.0	64.5
440	64.0	56.0	64.5	70.0
420	59.0	52.0	62.0	65.0

The spectrophotometer is able to check a new coloring matter even though the color of the undeveloped dye in solution does not resemble that of the finished dyeing. With the spectrophotometer the dyer will save considerable time in checking new products.

SOLUBILITY OF DYESTUFFS

The dyer can use transmittance measurements to test the relative solubility of a dyestuff. The usual procedure for testing this property of a dyestuff is as follows:

50 ml. boiling water is poured over 0.5 gm. dyestuff.
Stir well and filter through a weighed paper.
Wash with an additional 50 ml. of boiling water.
Dry the filter paper carefully and reweigh.
The increase in weight of the paper indicates the

amount of dyestuff left undissolved under the conditions of this test.

The spectrophotometer will shorten the time required for this analysis. With the spectrophotometer it is not necessary to weigh nor dry the filter paper. The amount of dyestuff which dissolves under the conditions of this test is determined by analyzing the filtrate. To show the value of this test, the results obtained with a chrome grey will serve as an example. Repeated analysis with this color showed that only 65 per cent will dissolve in water under the conditions of this test. Other tests were made using various wetting out agents to see whether the solubility could be improved. The dyestuff was pasted with these agents and water added to the paste. The results were as follows:

Solubility in water ..... 65 to 70 % Poor
Pasted with Sulfonated Oil ..... 85 to 100% Good
Pasted with Pyridine ..... 85 to 100% Good
Pasted with Deceresol OT 25%.. 65 to 70 % Poor

These results were in good agreement with the standard method of grading this test. Thus a dyer can check the solubility of a dyestuff, and at the same time determine the suitability of a wetting out agent.

In choosing his dyestuff the dyer gives due consideration to the color of the new product. The final selection, however, is rarely based on this factor alone. A good deal of attention must be given to the fastness properties of the coloring matter.

CROCKING

To show the suitability of this instrument for evaluating fastness test, the crocking standards of the American Association of Textile Chemists and Colorists were measured and the results shown in Table XIII (17):

TABLE XIII

AATCC Rating	*Dyestuff*	*Wave-length*	*Reflect.*	*Munsell No.*
Unsatisfactory	Victoria Blue B	610	57.0	6.55
Passable	Patent Blue A	610	79.0	7.50
Very Good	Alizarine Rubinol G .	610	100.0	8.50

Referring to Table XIII with the aid of the spectrophotometer we could divide the crocking standards of the A.A.T.C.C. into units of twenty as follows: Below 60 per cent reflectance the class is unsatisfactory, from 60 to 80 per cent reflectance the class is passable, from 80 to 100 per cent the class is good to very good. The spacings of 20 units can easily be subdivided by using the spectrophotometer. The smaller units will give us a better understanding of the degree of fastness of a dye to crocking.

Referring to the ever present demand of industry to adopt the Munsell grey scale as a yardstick to evaluate crocking fastness, the reflectance values of this scale was measured. In this case Munsell grey No. 8.5 was taken as the standard. The Munsell number in Tables XIII and XIV are evaluated with reference to the standard (No. 8.5).

For crocking fastness it is the intensity of the spot produced, not the spectral quality which determines the class of the dyestuff. Therefore it is necessary to make one measurement of the characteristic wavelength to obtain the reflectance value for this test.

The method of measuring is as follows: the test cloth is centered in one beam of the spectrophotometer (position E, Fig. 2). A piece of the same cotton cloth unused is placed in the reference beam. Both samples have a white background. The measurement is made by determining the reflectance of the lowest portion of the curve, the maximum absorption point.

On this basis the Forstmann Woolen Company has developed a set of crocking standards for the control of their blacks. The standards with their classification are shown in Table XIV.

TABLE XIV

Mill Rating	*Color*	M_μ.	*Reflectance*	*Munsell*
Reject	Black	600	46	Off scale
Passable	Black Acid ..	600	65	6.9
Passable	Black Neolan.	600	66	6.95
Good	Black	600	79	7.50

The spectrophotometer is not limited in evaluating fastness tests in the terms of intensity, but it can be used with equal effectiveness where a difference in color occurs. This is important when it is necessary to classify colors with respect to light fastness.

LIGHT FASTNESS

The American Association of Textile Chemists and Colorists has adopted the following dyestuffs as tentative standards in testing for light fastness[18]:

L1. Brilliant Wool Blue FFR Extra Poor
L3. Brilliant Indocyanine 6B
L5. Anthraquinone Blue RXO
L8. Indigosol Blue AGG

The standards were tested in the Fade-Ometer.

Curves showing the effect of light fading of a sample has already been published in the AMERICAN DYESTUFF REPORTER (19). The full spectrophotometric curves are not necessary to describe the change which has taken place due to fading of the material. For instance, to determine the relative amount of color destroyed by the conditions of the test, one measurement at the characteristic wavelength is necessary. For the same wavelength the unexposed part of the cloth compares with the faded part according to the following formula:

Unexposed part .....A
Exposed part .....B
Relative difference in % reflectance.....C

$$C = \frac{\text{Log}\,\frac{100}{A}}{\text{Log}\,\frac{100}{B}} \times 100$$

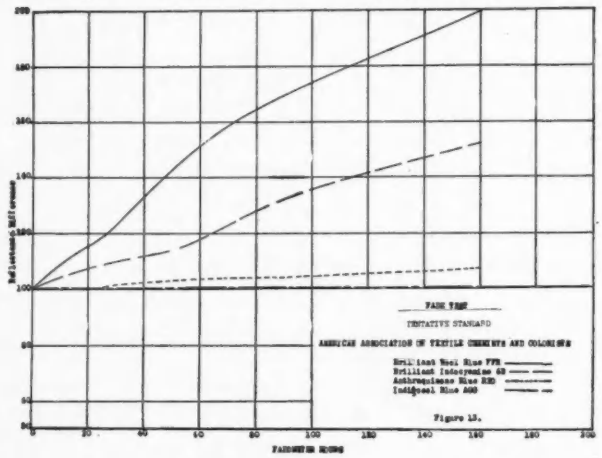
The standards of the American Association of Textile

Chemists & Colorists calculated as described above are shown in Table XV.

TABLE XV

Dyestuff	*Class*	*Mμ.*	*10 hrs.*	*20 hrs.*	*40 hrs.*	*80 hrs.*	*160 hrs.*
Brill Wool Blue FFR	L1	580	109	115	134	164	200
Brill Indocyanine 6B	L3	580	104	107	112	128	152
Anthra. Blue RXO	L5	580	100	100	102	104	107
Indigosol Blue AGG	L8	580	100	100	100	100	100

The reflectance difference of the various light standards show up well when the results are graphed, fig. 13. The



reflectance value for the untreated sample is represented on this graph as 100. Notice how Indigosol Blue AGG, a dye of good fastness, is shown as a straight line following the line of the original untreated color. Contrast this with the curve representing Brilliant Wool Blue FFR, a dye of poor light fastness.

Similar measurements were made on the standards exposed to sunlight under glass. The results are shown in Table XVI and graphed in fig. 14.

TABLE XVI

Sun hours exposed under glass	*Class*	*Mμ.*	*27 Hrs.*	*60 Hrs.*	*230 Hrs.*	*400 Hrs.*
Brilliant Wool Blue FFR	L1	580	142	170	182	185
Brilliant Indocyanine 6B	L3	580	112	134	168	178
Anthraquinone Blue RXO	L5	580	100	100	110	125
Indigosol Blue AGG	L8	580	100	100	100	100

Comparing the results in tables XV and XVI, Brilliant Wool Blue FFR fades faster in a given time outdoors than in the Fade-Ometer. Brilliant Indocyanine fades at about the same rate in both cases. Anthraquinone Blue RXO suffers a greater change in the Fade-Ometer than in sunlight for a given time. Indigosol Blue AGG holds under both conditions.

To adequately show a change in color more than one measurement must be made. For the standards of the American Association of Textile Chemists & Colorists three reflectance values are given, one at the point of maximum absorption, the other two at the peaks on either side.

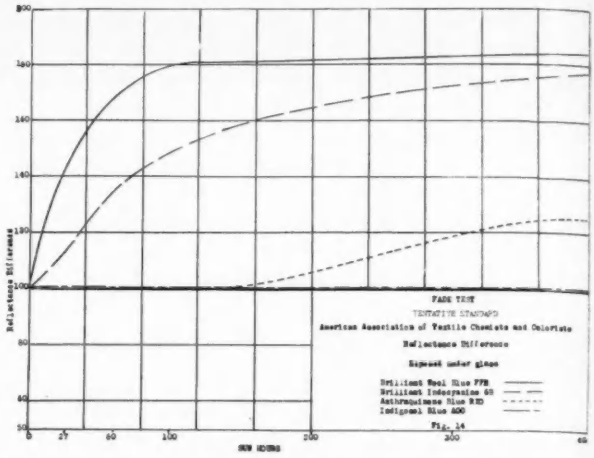


TABLE XVII
Fade-Ometer Test

Color	*Mμ.*	*Original*	*10 hrs.*	*20 hrs.*	*40 hrs.*	*80 hrs.*	*160 hrs.*
Brilliant Wool Blue FFR							
Red	660	100	93	96.5	107	121	142
Yellow	580	100	109	115	134	164	200
Violet	440	100	86	85.5	89.4	99	115
Brilliant Indocyanine 6B							
Red	660	100	103	105	109	123	135
Yellow	580	100	104	107	112	128	152
Violet	440	100	85	80	75	73.8	80.3
Anthraquinone Blue RXO							
Red	660	100	99	96.5	90	90	85.5
Yellow	580	100	100	100	102	104	107.0
Violet	440	100	99.5	95.5	94	91.2	89.0
Indigosol Blue AGG							
Red	660	100	100	100	100	100	100.0
Yellow	580	100	100	100	100	100	100
Violet	440	100	100	100	100.3	100.3	100.3

To fully understand the results expressed in Tables XVI and XVII we must keep in mind that the samples are taken from the same piece, and that two color curves are being compared. Now if the treated sample is unaffected by the test the two curves will coincide. Thus a perfect match is attained when the reflected values of the sample are equal to the corresponding values for the standard throughout the visible field.

To avoid negative numbers the reflectance values for the standard are placed at 100. In this manner a perfect match may be defined graphically as a straight line having the value of 100. Any deviation from this value indicates a difference in color. If the values are all less than 100 the color is darker, if the values are greater than 100 the color is lighter. Here with a few values, quickly determined by the spectrophotometer, color differences can be expressed with numbers on a relative basis, an asset to any test.

CARBONIZING FASTNESS

As an additional illustration, the method was used to evaluate the fastness of a dye to carbonizing. In the tentative procedure adopted by the A.A.T.C.C., the following three dyestuffs were recommended as representative of the three fastness grades (20).

C.I. 1034 1. Alizarine Red WS—Poor—a dyestuff which changes materially in the acid bath and does not return to shade on rinsing with water.

C.I. 853 2. Acid Cyanine B—Moderate—a dyestuff which changes seriously in acid but returns to shade with a water rinse.

C.I. 1073 3. Alizarine Irisole R—very good—a dyestuff which is unaffected by the entire method of carbonizing and neutralizing.

The changes which these dyes undergo are reflected clearly when measured with the spectrophotometer, Table XVIII.

TABLE XVIII

Alizarine Red WS *Spectral Color*	$M\mu$.	*Bef.*	*In Acid*	*Water Rinse*	*Soda Treatment*
Red	660	100	194	100	80
Blue-Green ..	510	100	162	118	120
Violet	440	100	100	100	114
Acid Cyanine B					
Red	680	100	152	100	93
Yellow	580	100	125	102	97
Violet	450	100	100	102	97
Alizarine Irisole R	680	100	98	98	97
Green	560	100	98	98	104
Violet	440	100	98	98	102

The color changes expressed by the above figures are in perfect agreement with the color differences as seen by the eye.

Alizarine Red WS suffers a great change when immersed in acid. The water rinse restores the red but the color has lost brilliancy. The neutralizing in soda does not restore the color. The final shade is dull and has a blue cast.

Acid Cyanine R changes appreciably when immersed in acid. The color is restored with the water rinse. The soda treatment tends to deepen the color.

Alizarine Irisole R maintains its color throughout the carbonizing, rinsing, and neutralizing operation. The final shade is slightly lighter and brighter than the original color.

SUMMARY

The main trouble with most systems used to describe color today, is that they lack a standard observer. The color systems name a color accurately, but without a standard observer names of colors are meaningless. Further, knowing the name of a color will not help the dyer materially in obtaining the shade.

All spectrophotometers have a constant light source, also uniform viewing conditions, thus the standard observer is provided for. All spectrophotometers express colors, simply and accurately, in the form of a curve. Some spectrophotometers automatically record the color curve. The unique feature of the Duplex spectrophotometer is that two color curves are instantly produced on a cathoderay tube. These curves can be plotted, or they can be examined on the machine, thus a direct comparison can be made.

Working with the Duplex Spectrophotometer we have been able to measure the reflectance of finished colors, evaluate dyestuff shipments, determine exhaustion of a dyebath, test new dyestuffs against a known product, check the solubility of a dyestuff, evaluate the fastness of a dye to crocking, light, and carbonizing. All of this data concerning color can be collected by an operator who has had no previous experience with color matching. It has been shown that comparative data obtained with the spectrophotometer agrees in the main with the visual inspection of the sample.

The best results are obtained with transmittance work. Reflectance data is useful in testing fastness properties, and to establish relative reference curves for colors. There is still a lot of work to be done with reflectance work before the dyer can use reflectance curves effectively in matching colors. In production, however, reflectance curves are useful for control purposes.

The Duplex spectrophotometer is a new instrument as far as the textile industry is concerned. Even in the comparatively short time the machine has been used it has pointed the way to establish a control over the dyeing operations by expressing colors and color differences with definite numbers based on well known scientific principles. By continued use of the spectrophotometer its scope will be widened and the art of dyeing will eventually become a science.

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OBITUARY

HARRISON E. HOWE

DR. HARRISON E. HOWE, for 21 years editor of *Industrial and Engineering Chemistry*, official publication of the American Chemical Society, died recently at his home in Washington. He was 61 years old. Dr. Howe had been suffering from heart trouble since last Spring but had been active until about 3 weeks before his death.

Dr. Howe was one of the best known members of the chemical profession and on November 6th had been awarded the annual medal of the Society of Chemical Industry for "valuable application of chemical research to industry."

EDWARD P. BOSSON

EDWARD P. BOSSON, president and treasurer of Bosson & Lane, Inc., manufacturing chemists of Atlantic, Mass., died suddenly on December 13th. He was 78 years old.

Mr. Bosson founded the firm of Bosson & Lane in 1894, following several years experience as a dyestuff salesman. He was a member of the Boston City Club, the Boston Credit Men's Association, the Associated Industries of Massachusetts, the American Chemical Society, and the Chambers of Commerce of Boston, Quincy and Newton.

He is survived by two daughters and a grandson.

• ANNUAL MEETING, S.O.C.M.A.

The twenty-first annual meeting of the Synthetic Organic Chemical Manufacturers Association was held on Tuesday, December 15th, at the Chemists' Club, New York City.

The business meeting convened about 3:30 and was followed by a program of speakers including: S. C. Moody of the Calco Chemical Division, American Cyanamid Co. and a member of the Dyestuff Advisory Committee of the W.P.B. who spoke on the work of that committee; R. E. Dorland of the Dow Chemical Co. who spoke on the subject of steel drum limitations; Arthur W. Mudge of the Aromatic Products Co. and chief of the plant facilities branch of the Chemical Division of the W.P.B. who spoke on the work of this branch; Morrison G. Tucker, assistant to the Alien Property Custodian who spoke about the policy to be followed in the administration of patents and patent applications vested in the custodian; Robert E. Waterman, special consultant on chemical patents in the office of the Alien Property Custodian who enlarged on Mr. Tucker's talk; and E. H. Killheffer of E. I. duPont de Nemours & Co., Inc., who spoke on the subject of tariffs.

The speaking program was followed by an informal dinner.

The next general luncheon meeting will be held on Wednesday, January 13th.

• HARRIS TO SPEAK

Dr. Milton Harris, research director of the Textile Foundation, will be the speaker at a meeting of the Rhode Island Section of the American Chemical Society to be held in the Metcalf Auditorium of Brown University on January 15th at 8:15 p.m. Members of the A.A.T.C.C. are invited to attend.

• DCAT ELECTS OFFICERS

The organization meeting of the newly elected Executive Committee of the Drug, Chemical and Allied Trades Section of the New York Board of Trade was held on Thursday, December 10, at the Chemists' Club, 52 E. 41st Street, at 12:15 p.m. The primary purpose of this meeting was the election of officers to serve for the next fiscal year, the results of which follow: Chairman, Victor E. Williams, Eastern Sales Manager, Monsanto Chemical Company; Vice-Chairman, Charles C. Caruso, Vice President, Schieffelin & Company; Treasurer, Robert B. Magnus, Vice President of Magnus, Mabee & Reynard, Inc. (re-elected). Carl M. Anderson, Assistant Secretary, Merck & Co., Inc., was re-elected Counsel, and John C. Ostrom was re-elected Secretary.

The retiring Chairman, S. Barksdale Penick, Jr., President of S. P. Penick & Company, automatically becomes a member of the Section's Advisory Council, to succeed Joseph A. Huisking, Vice President of Fritzsche Brothers, Inc.

Plans were laid for the 18th Annual Banquet to be held in March. Announcement will be made shortly concerning committees in charge.

The final report of the Membership Committee made by Harold M. Altshul, Chairman, revealed that 68 new members had joined the Section during the current year bringing the total membership to a new high of 385.

• THREE NEW MIXERS

Mixing Equipment Co., Rochester, N. Y., announces the addition to their regular line of three new heavy duty air driven mixers. Two of them are gear reduction models. The third is a larger direct drive model.

The important features of these mixers are said to especially adapt them to the mixing of paints, chemicals, high explosives and alcoholic compounds. It is stated that the air driven motors used in these mixers cannot be overloaded or burned out. Even when used in the heaviest liquids they will not stall. The air exhaust from the motor is so arranged that it keeps the motor running cool at all times.

Models of 1 h.p. and 1-3 h.p. are available. They are equipped with gear reduction drive and adjustable shaft length.

• AWARDED "E" PENNANT

The Nylon Research Laboratory and Pilot Plant, where the synthetic fiber was nurtured and later trained for military service, received the Army-Navy "E" pennant on December 29. This was announced by L. A. Yerkes, general manager of the Du Pont Company's Rayon Department.

This was the third Production Award ceremony held for nylon units of E. I. du Pont de Nemours & Company, and the sixteenth held in Du Pont plants. The Seaford, Delaware, and Martinsville, Virginia, nylon plants received the award earlier.

The presentation on December 29 was made at the Du Pont Country Club, close by the Experimental Station where the Nylon Research Laboratory and Pilot Plant are located. Brig. Gen. Benjamin W. Chidlaw of the Materiel Command of the Army Air Forces made the presentation.

Robert P. Patterson, Under Secretary of War, in his letter to "the men and women of the Nylon Research Laboratory and Pilot Plant," announcing the award, wrote:

"This is to inform you that the Army and Navy are conferring upon you the Army-Navy Production Award for high achievement in the production of war material.

"Your patriotism, as shown by your remarkable production record, is helping our country along the road to victory. May I extend to you men and women my congratulations for accomplishing more than seemed reasonable or possible a year ago?

"In conferring this award, the Army and Navy will give you a flag to fly above your plant, and will present to every individual within it a lapel pin symbolic of leadership on the production front."

Dr. G. P. Hoff, director of the Nylon Research Section, acknowledged the announcement as follows:

"It is a very great pleasure to acknowledge, on behalf of the Men and Women of the Nylon Research Laboratory and Pilot Plant, your letter stating that

the Army and Navy have seen fit to confer upon us the Army-Navy Production Award for high achievement in the production of war material.

"We are pleased and proud that this honor is to be bestowed upon us, and hope through our continuing efforts, to merit in every way the tribute that this award represents."

The fiber which today is being made into vital military equipment had its origin in fundamental research started by the Du Pont Chemical Department at the Experimental Station fourteen years ago. It was begun for the purpose of arriving at a better understanding of polymerization—the union of small molecules of a chemical to form larger molecules of essentially the same substance but with different physical properties. Eventually a material was produced during these experiments which seemed suitable for the spinning of textile fibers. After several years of hard work a product was developed having greater combined strength and elasticity than that of any synthetic textile fiber known. This was nylon.

• CHIEF, FIRE DEFENSE SECTION

L. W. Hutchins, President of Sheldon, Morse, Hutchins & Easton, Inc., and Director of Safety Research Institute, Inc., of New York City, has been appointed Chief of the newly organized Education Unit in the Fire Defense Section of the U. S. Office of Civilian Defense.

The function of this new unit in the OCD will be to direct public education on fire defense. It will also serve as a coordinating agency in matters of fire defense between the various OCD divisions and between the OCD and other government agencies.

As Director of Safety Research Institute, which is active in fire protection education, Mr. Hutchins has been closely associated with the fire safety field for a number of years. He is a member of the National Fire Protection Association, the Agricultural Committee of the National Fire Waste Council, the National Safety Council, and a number of similar organizations.

• CORPOLIN

The scarcity of glycerin for civilian use in war time has necessitated substitutes which, however, are said to duplicate only a small part of the original's properties. A substitute having, essentially, the viscosity of glycerin, may lack the hygroscopic property, etc. It is claimed that Corpolin, a product of the Aktivin Corp., 50 Union Square, New York City, is a physical substitute as far as hygroscopicity is concerned, and that it excels glycerin in this respect considerably, as is shown below.

It is stated that Corpolin is a heavy, odorless, and colorless liquid which does not discolor in storage, is non-volatile and non-inflammable. It is said to be miscible with water, alcohol, methanol, glycerin, formaldehyde; to exert a swelling effect on gums; to prevent glue or gelatine solutions from gelatinizing. The pH is 7.0 to 7.2. Corpolin loses its hygroscopicity in the acid range. On heating, it begins to decompose at 140° C. On cooling to the zero point or lower, it becomes a viscous gel; a 10 per cent solution (by weight) freezes at —4.6° C. (24° F.), a 25 per cent solution at —11.5° C. (9° F.).

In the following, a comparison is drawn between some of the properties of Corpolin and glycerin.

Specific gravity. Corpolin, 1.535; glycerin, 1.260. One gallon of Corpolin weighs 12.8 lbs.; glycerin, 10.5 lbs. It is stated that a solution of 6 lbs. of Corpolin to the gallon is as heavy as one gallon of pure glycerin. The high specific gravity is responsible for the name Corpolin, derived from corpus.

Moisture Attraction. Any quantitative figures about hygroscopicity must be accompanied by the conditions under which they were obtained, otherwise they are worthless. It is stated that the values listed in Fig. 1 were obtained with 14 cc. Corpolin (21.206 g.) and 14.5 cc. glycerin (18.294 g.), placed in Petri dishes of 97 mm. inner diameter, exposed to an air of 100 per cent relative humidity at 27° C. for 10 days. There are two curves for each agent: the heavily dotted curves show the percentages of picked up moisture related to the weights; the circled curves, related to the volume of the agents applied.

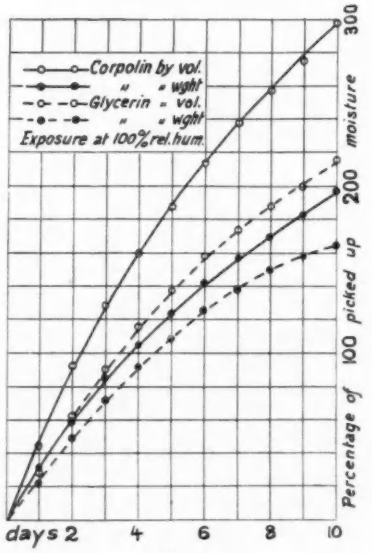


Fig. 1

Moisture Retention. Perhaps more important than the quantity of moisture picked up is the amount of it retained. It is stated that solutions of 22 cc. of Corpolin and 22 cc. of glycerin, each containing 11 cc. of water, were exposed to the open air in Petri dishes of 97 mm. inner diameter at an average temperature of 21° C. for 2 days. The changes of weights after 24 and 48 hours show the change of moisture content at the prevailing relative humidities. Fig. 2 illustrates the changes of the moisture contents expressed in percentages relative to the moisture present when the trial was started.

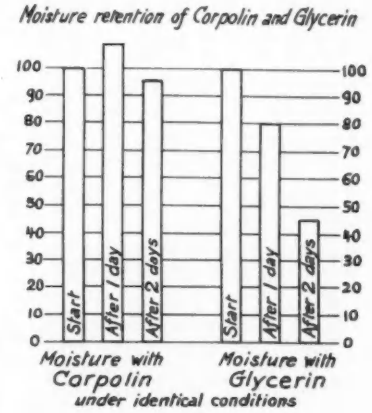


Fig. 2

At the prevailing atmospheric conditions on the first day, Corpolin solution picked up about 8 per cent more moisture while the glycerin solution lost 20 per cent of its moisture content at the same time.

Capillarity. It is stated that when 50 per cent solutions of Corpolin and glycerin in water (by volume) were allowed to ascend in heavy blotting paper at a room temperature of 27° C, within one hour the liquids rose to 60 mm. and 39 mm. respectively. Figure 3 illustrates the ascension graphically.

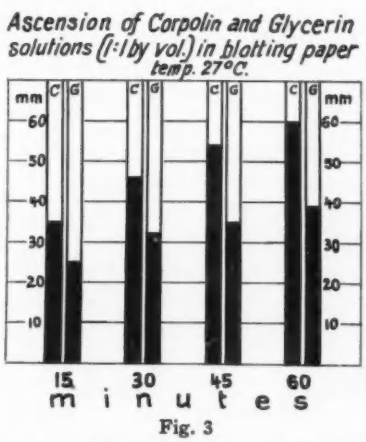


Fig. 3

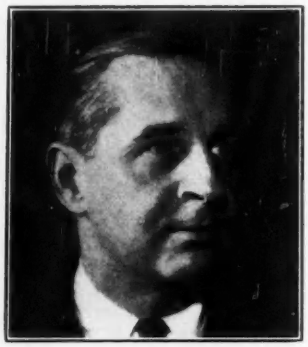
It is claimed that Corpolin solutions penetrate capillaries more easily than do glycerin solutions of the same concentra-

tion: a distinct advantage for impregnating purposes. It is said to seep through very fine pores; even hardwood barrels are said to begin to leak after a few hours. *Viscosity* is 7 centipoises at 25° C, similar to that of a glycerin solution of about 53 per cent.

It is stated that Corpolin was already in commercial use before glycerin became scarce.

• PERSONNEL CHANGES AT ARIDYE

Chester M. Robbins, formerly Sales Manager of the Southern Division of Aridye Corp. has been appointed Vice President and will hereafter make his headquarters at the home office in Fair Lawn, N. J. Mr. Robbins' function in his new office will be to concentrate upon the presentation of new, fundamental developments in pigment-dyeing and pigment-printing in all territories in which Aridye Corporation is active.



Chester M. Robbins

William B. DePass, who for a number of years has been working with Mr. Robbins in the Southern Territory, is taking over the management of this Division. He will be assisted by Clovis Powell. Both have had many years of plant experience before joining the Aridye organization.

The service staff in the Southern Division will be augmented January first by John W. McCalla who comes to Aridye from National Aniline and Chemical Co., where he has been a technician for several years. Prior to that, he had plant experience as dyer and chemist.

Arthur McLean is joining the service staff at Fair Lawn on January first. He was associated with Pacific Mills for a number of years and more recently with Cold Spring Bleachery.

Richard M. Johnson has just been added to the technical staff. Until recently he was chemist in the dyehouse of Celanese Corporation, Cumberland, Maryland, and brings to Aridye ten years of experience in the printing, dyeing and finishing of acetate fabrics and mixtures.

Arthur Booth, in charge of the textile dyeing and processing department at Paterson Vocational School and for many years a consultant and analyst for textile plants in the New York area, has joined the Development Laboratories at Fair Lawn.

• DECEMBER ISSUE, TEXTILE RESEARCH

A practical method that has been developed for laying a thin sheet of parallel fibers bonded with plastics is described in the December issue of *Textile Research*, official publication of Textile Research Institute, Inc. and the Textile Foundation. Experiments indicate that plastics, with as high as 75 per cent of cotton, can be molded from these thin laminations and with resulting tensile strengths comparable to metals in their strength-in-relation-to-weight factors.

Further studies by the Research Associates of the Textile Foundation lead to a better understanding of the chemical action of more complex dye baths in the dyeing of wool and indicate that certain chemical agents will give a better exhaustion of the dye bath and more level dyeing.

The finest scientific investigations are of no practical significance to the industry if they cannot be interpreted into intelligent and active use. Professor Edward R. Schwarz, of M.I.T. discusses modern facilities and requirements for research and the need of better training for the research worker and better understanding of the problems on the part of the manufacturer.

Other features of the December issue include Lieut. Col. Frank M. Steadman's discussion of the problem of tendering of cotton fabrics, given in his opening remarks at the recent annual meeting of the Textile Research Institute. Excerpts are given from the address by Dr. C. E. K. Mees. Also included is the report of the Thirteenth Annual Meeting of Textile Research Institute and Mr. F. S. Blanchard's report on the past year's progress and prospects for the future.

• JOINS AMERICAN VISCOSE

Walter C. Hauer, graduate of the New York School of Textile Technology, has joined the American Viscose Corporation and will be in charge of the fabric testing laboratory of the company's New York office.

OPEN FORUM

57—With the government denial of bleaching powder and sodium hypochlorite to many, for use in cleaning the deeply, dye-stained hands of employees at the end of the day's work, we among others, are confronted by the difficult problem of finding a satisfactory substitute for bleaching these basic color, or nigrosine stains.

I am most earnestly writing to ask if you, or someone, can tell us: (1) if there is a provision in the priority restrictions for issuance of bleaching powder to textile mills whose workers get deeply dye stained hands, for cleaning (bleaching) off these colors, which our Purchasing Agent may have overlooked, or (2) what substitute chemicals may be used to remove basic colors (like methyl and crystal violets) from the skin.

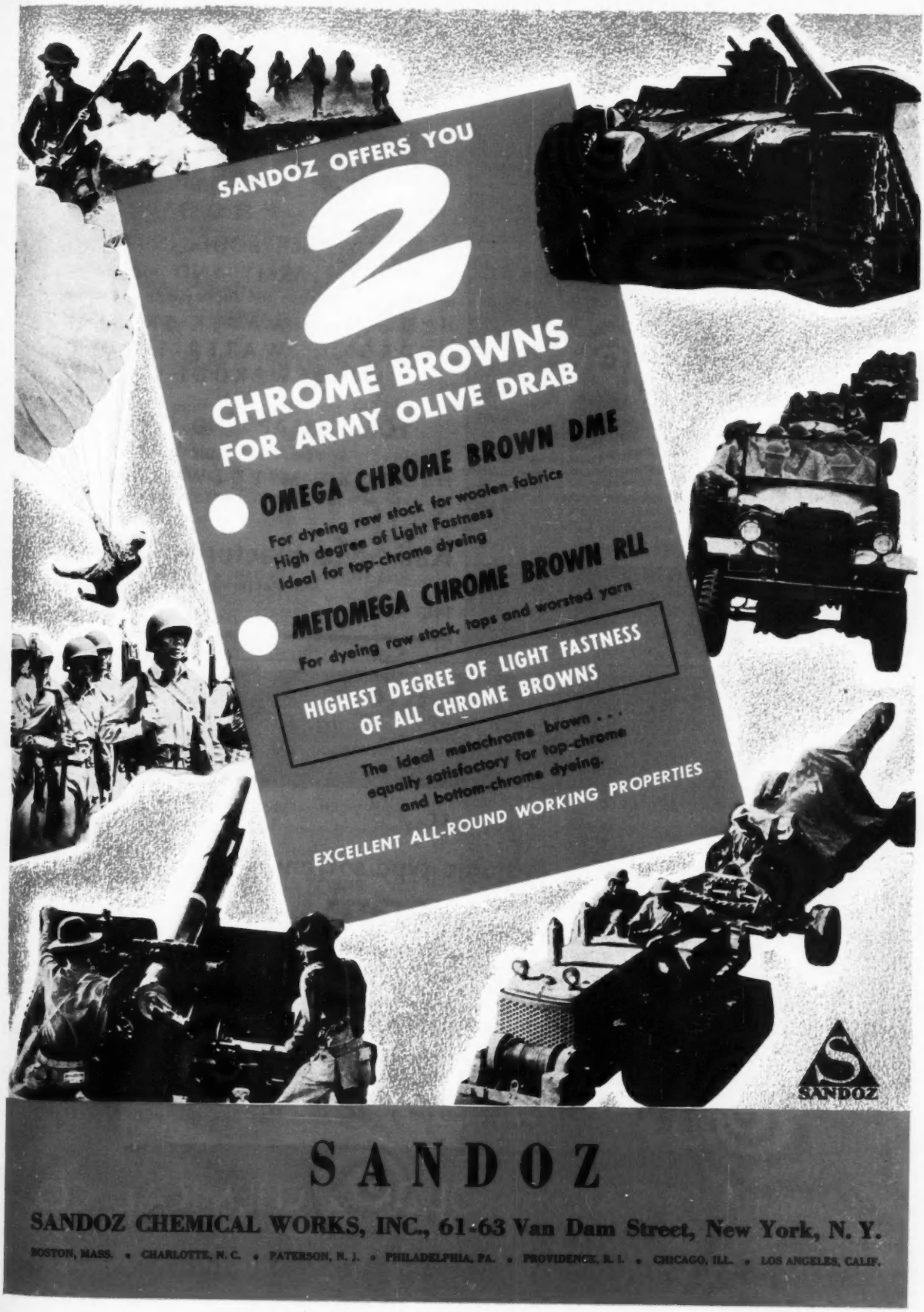
It appears likely that this problem may very soon, if not already, be of widespread concern to Reporter readers.

Whatever help you can give us will be much appreciated.—**J.G.N.**

• CLASSIFIED • ADVERTISEMENTS

The rate for "Position Wanted" advertisements in this column is 2 cents a word—with a minimum of 50 cents per insertion. For all other types of advertisements—i.e., help wanted, machinery or supplies for sale—the rate is $6.25 per column inch or less per insertion.

WANTED: Dye salesman and technician qualified to sell rayon dyestuffs in eastern markets for manufacturer of dyes and chemicals. State education, experience and starting salary. Write Box No. 416, American Dyestuff Reporter, 440 Fourth Ave., New York, N. Y.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For dyeing raw stock for woolen fabrics
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OF ALL CHROME BROWNS
The ideal metachrome brown . . .
equally satisfactory for top-chrome
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EXCELLENT ALL-ROUND WORKING PROPERTIES
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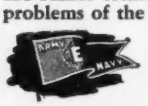
Yank dyes hold fast

NOT by accident do U. S. dyes outlast climatic tortures from Iceland's icy waters to Tropic sands and jungles. Our military colors maintain fastness under the most terrific field conditions ever seen because American dyestuffs—products of the American chemical industry—have reached a state of dependability never before attained by them.

HOOKER *Chemicals*

help maintain that dependability. Their purity and unvarying compliance with specifications enable dye manufacturers to guarantee predictable properties under known conditions. The HOOKER technical staff is ready to help solve any chemical problems of the dye industry.



A few of the HOOKER chemicals for the dye industry are: Acetyl Chloride, Benzal Chloride, Caustic Soda, Cyclohexanol, Meta Nitrobenzoyl Chloride, Muriatic Acid, Sodium Sulfide.

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FOR ARMY AND NAVY
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HYDROXY* WATER-SHIELD "D".
HYDROXY* WATER-SHIELD and
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FOR BURLAP AND OSNABURG
for use in Sand Bags.
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Two new cationic type softeners

TEXAMINE

a pure white permanent softener economical to use due to its complete exhaustion qualities

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a permanent softener and desizing agent for processing grey goods in the kier eliminating the customary grey desizing.

May we serve you?

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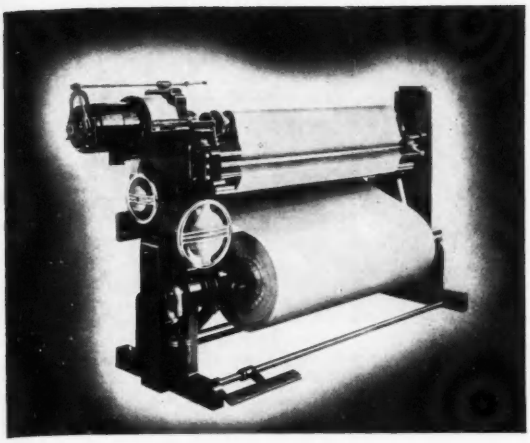

CONSTANT CLOTH SPEED UP TO 200 YARDS PER MIN.

With this tuber, increased speed up to 200 yards a minute is possible, under complete control and with constant cloth speed. Tension can be adjusted from tensionless to the maximum on the package—easily and quickly by the operator.

The let-off is so designed and placed that it can be easily and quickly loaded. Let-off and take-up are both on the operator's side of machine—saving time and floor space.

Measuring is accurate and dependable, since tension between the let-off and measuring drum has been reduced to the minimum.

Start, stop, let-off, take-up and measuring drum are synchronously controlled by operating one foot pedal.

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OTHER IMPORTANT FEATURES

Ball bearings are used throughout.

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No crystal ball is needed to learn the future of Rayon. Through such team work as exemplified by Onyx Research—Onyx Laboratories—Onyx Production, in close cooperation with mills and commission dyeing and finishing plants is determined the future of Rayon, particularly in the hosiery field. Experience, work and patience well directed, are gradually surmounting many obstacles. If you have a problem in Rayon, perhaps Onyx can be of help. Your inquiries are solicited.

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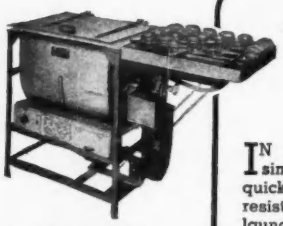
ATLAS-OMETERS



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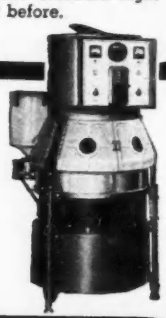
IN Atlas-Ometers you have a simple, easy way to learn, quickly, how your products will resist fading, or deterioration from laundering. Atlas-Ometers have been a valuable mainstay of the textile industry for over a quarter of a century. Their time-saving guidance is more essential right now than ever before.

LAUNDER-OMETER — Standard laboratory washing machine of the A. A. T. C. C.— measures resistance to washing action, shrinking, staining, color fastness to soaps and solvents. All factors carefully controlled—can be produced exactly at any time.



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APRIL	12-26
MAY	10-24
JUNE	7-21
JULY	5-19
AUGUST	2-16-30
SEPTEMBER	13-27
OCTOBER	11-25
NOVEMBER	8-22
DECEMBER	6-20

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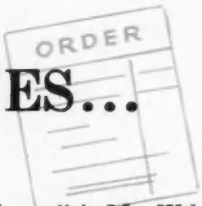

the "quality or status of taking precedence," is Mr. Webster's way of saying "*first things first.*" However,

P also stands for PROGRESS...

defined here at Cyanamid in terms of chemical advancement and contributions to users of chemicals in industry. Priorities, therefore, and all the necessary limitations these must continue to imply become a patriotic challenge to our resource, experience and ingenuity to help relieve critical shortages of essential chemicals.

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